

**FINAL REPORT
for
SITE INSPECTION
at
INSTALLATION RESTORATION SITE 1
NAVAL AND MARINE CORPS RESERVE CENTER
LOS ANGELES, CALIFORNIA**

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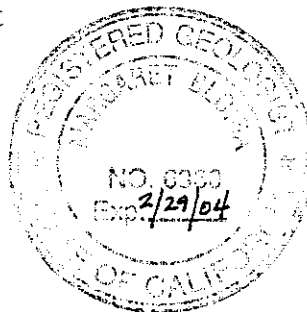
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**Final Report
for
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at
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Naval and Marine Corps Reserve Center
Los Angeles, California
Delivery Order No. 024**

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EXECUTIVE SUMMARY

This Draft Report presents the results and findings for the Site Inspection (SI) performed by CDM Federal Programs Corporation (CDM Federal) from October 1999 to February 2000 at Installation Restoration (IR) Site 1, Naval and Marine Corps Reserve Center-Los Angeles (NNCRC-LA), Los Angeles, California. The SI was performed for Southwest Division Naval Facilities Engineering Command (SWDIV) under Contract No. N68711-96-D-2029, Delivery Order Number 24. An SI is an environmental investigation to assess the nature and extent of potential releases to soil and/or groundwater, assess risk, and recommend possible mitigation alternatives or no further action.

Site History

IR Site 1 consists of a former vehicle service station and a vehicle lube rack area in NMCRC-LA, located one mile northeast of downtown Los Angeles near Elysian Park and Dodger Stadium. CDM Federal performed the SI and IR Site 1 to investigate (1) potential leakage from an underground storage tank (UST) that held gasoline at a former vehicle service station and (2) potential leakage of contents from hazardous waste drums stored at a vehicle lube rack that drained to a former waste oil UST. Subsurface soil sampling performed in 1996 identified gasoline, benzene, toluene, ethylbenzene, total xylenes, and 1,2-dichloroethane (DCA) in soil samples collected in IR Site 1.

Site Investigation

The SI was performed in two phases and included the following main task:

- Geophysical surveying to identify whether the gasoline UST has been removed;
- Soil sampling and analysis;
- Groundwater sampling and analysis;
- Assessing the nature and extent of contamination;

- Assessing the fate and transport of contaminants, including assessing whether natural attenuation of petroleum hydrocarbons is occurring or may occur; and
- Assessing potential risk to human health.

Findings

The geophysical survey, using ground penetrating radar, metal detection, and electromagnetic detection, did not find evidence of a UST still in place below the ground surface. It is likely that the UST was removed prior to the mid-1980s as previously reported.

The drilling and well installation activities indicate that groundwater occurs at depths ranging from 27 to 35 feet below ground surface at NMCRC-LA. Based on hydraulic gradient measurements, groundwater flows to the south-southeast.

Sample results indicate the type of contaminants identified in soil and groundwater consisted primarily of petroleum hydrocarbons. Total petroleum hydrocarbons (TPH) in the gasoline range and, to a lesser degree, in the diesel range, were detected. Benzene, toluene, ethylbenzene, and xylene (BTEX) were several of the fuel analytes detected in soil and groundwater samples, along with 1,2,4-trimethylbenzene (TMB) and 1,3,5-TMB, naphthalene, and 2-methylnaphthalene. All of these analytes are components of gasoline.

No free product or oily sheen in groundwater samples was observed. Petroleum hydrocarbon odors and stained soil were observed in some samples in the area of the former gasoline UST.

1,2-DCA was detected in both soil and groundwater samples. 1,2-DCA was historically used as a gasoline additive. The absence of other chlorinated hydrocarbons such as trichloroethylene (TCE) suggests that 1,2-DCA detected at this site was most likely a result of fuel use, rather than solvent use.

TPH and VOCs concentrations in soil and groundwater were highest where the gasoline UST is suspected to have been located (between the lube rack and vehicle maintenance building).

Lower or nondetect concentrations of TPH and VOCs were detected at locations more distant from the source area.

Concentrations of analytes that are relatively highly degradable, such as benzene, were identified in groundwater near the source area (benzene maximum of 588 $\mu\text{g/L}$) and at lesser concentrations a short distance away (nondetect 100 and 200 feet downgradient).

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Concentrations of analytes that are less degradable, such as TMBs (maximum 1450 $\mu\text{g/L}$ in the source area), were identified in groundwater at a greater distance away from the source area (8 $\mu\text{g/L}$ 100 feet downgradient, nondetect 200 feet downgradient). The analyte 1,2-DCA, which is more recalcitrant than non-chlorinated petroleum hydrocarbons, was detected in groundwater at lower concentrations (28 $\mu\text{g/L}$ in the source area) and further downgradient from the source area (8 $\mu\text{g/L}$ 100 feet downgradient, 3 $\mu\text{g/L}$ 170 feet downgradient, nondetect 200 feet downgradient).

Soil and groundwater sample results were compared to conservative screening criteria, which consisted of residential United States Environmental Protection Agency (EPA) Region IX preliminary remediation goals (PRGs) for soil and EPA maximum contaminant levels (MCLs) for groundwater (or PRGs if MCLs do not exist for a specific groundwater analyte). Because the maximum concentration of at least one analyte exceeded screening criteria for both soil and groundwater, additional data evaluation was conducted. The purpose of this additional data evaluation was to assess the fate and transport of contaminants and to more accurately assess the magnitude of potential impacts to human health that might be posed by site contamination.

Fate and Transport of Contaminants

To support the human health risk assessment (HHRA), the fate and transport of contaminants in both soil and groundwater were assessed. The assessment provided an estimate of the degradation of petroleum hydrocarbon contaminants that naturally occurs with compounds such as gasoline, as well as estimated concentrations of analytes in groundwater that might extend beyond the NMCRC-LA property boundary in the future.

The results of the fate and transport assessment indicate that residual concentrations of indicator chemicals (e.g., benzene, TMBs, 1,2-DCA, naphthalene, and lead) that were assessed are present in soils at sufficient concentrations to continue to act as a source of contamination to groundwater in the future. Concentrations in groundwater are likely to remain near their current concentration for some time into the future due to this ongoing residual source. The fuel-related hydrocarbons (e.g., BTEX, TMBs, and naphthalene) are undergoing significant degradation by natural biological processes at the site, further limiting the mobility of these compounds. The fuel compounds have likely reached a steady state and will not expand significantly in the future. The 1,2-DCA is less degradable due to the presence of abundant sulfate in the ground water. The fate and transport of lead was evaluated, and the results indicate that it is almost immobile due to its high degree of sorption onto the soil matrix.

Human Health Risk Assessment

Human health risk was assessed following EPA and State of California Department of Toxic Substances Control (DTSC) guidelines. The source area of contamination was located several feet underground and no drinking water wells are located in the area. Because the site is paved with asphalt or concrete, no human receptor exposure pathways are considered to exist at the current time. However, future changes in site characteristics or use, such as installation of drinking water wells, removal of pavement, or industrial or residential development could possibly lead to potential exposure of humans to identified site contaminants. The HHRA was performed for all chemicals of potential concern (COPC) and also for only those COPCs not related to the petroleum contaminant (i.e., gasoline constituents).

The future scenarios for potential human exposure included in the HHRA for this site are the following:

- Exposure of construction workers to site contaminants during activities such as excavation of soil during construction of a building foundation;

- Industrial exposure to site contaminants after removal of the pavement covering the site and industrial development of the site;
- Residential exposure to site contaminants after removal of the pavement covering the site and residential development of the site; and
- Residential exposure to site contaminants in groundwater after installation of groundwater wells for domestic use in the contaminated groundwater onsite or in an offsite downgradient area potentially impacted by contaminants in the future.

These scenarios are considered unlikely to occur due to the likely future use of the site (fire fighting training and administration). Evaluation of these scenarios for potential impacts to human health was performed to provide a health protective estimate of the potential future risks presented by exposure to site contaminants.

The results of the HHRA for all COPCs indicate that soil contamination does not present an unacceptable risk to human health under the future scenarios assessed. For groundwater, if a drinking water well were to be installed just off the NMCRC-LA property, exposure to groundwater contaminants could possibly present a risk to human health under a future residential scenario. The majority of calculated risk is associated with groundwater that might be consumed and inhalation of vapors during showering.

The HHRA results for the non-petroleum related COPCs indicate a acceptable risk to human health under the future scenarios assessed when compared to other constituents.

These HHRA results are based on conservative assumptions and could be three orders of magnitude lower (i.e. 1,000 times lower) if evaluated using more realistic parameters. Additional calculations reveal even lower risk than presented in this report. The risk assessment results should be evaluated with an understanding of the following qualifiers to better understand the conservative estimates of potential risk and hazard by exposure to groundwater contaminants:

- The groundwater beneath the site is not very suitable for drinking purposes due to its high total dissolved solids (TDS), chloride, and sulfate concentrations, as well as the likelihood that any well installed at the site would yield an unsustainable flow rate.
- It is unlikely that a drinking water well would be installed directly adjacent to the NMCRC-LA property line where contaminants might migrate offsite.
- Sample collection from the NMCRC-LA site was biased towards areas of contamination, which increased the average contaminant concentration used in the risk assessment calculations.
- Fate and transport modeling calculations were very conservative and produced conservative results that were used in the risk assessment future scenario;
- Metals concentrations used in the HHRA for groundwater at the property boundary were very conservative.
- Chloroform was included in the HHRA, but it was detected at the highest concentrations at the two upgradient background groundwater sampling locations and was not a suspected site contaminant from the gasoline UST.
- Toxicity values derived from animal studies at high doses have large safety factors built into them (e.g., factors of 100) to err on the side of conservatism.
- Use of upper-bound exposure assumption values carried through multiple calculations propagates the conservatism of the resulting calculations.
- In addition to the level of conservatism added by each of the factors identified above, the HHRA used a reasonable maximal exposure (RME) in the risk assessment calculations, which produces higher estimates of risk than more realistic or average case scenarios.

Based on these results, CDM Federal recommends that the site no longer be considered a CERCLA IR site, but should fall under the State of California's Leaking Underground Fuel Tank Program. CDM Federal also recommends quarterly groundwater sampling and analysis for the contaminants of concern be conducted for two years to assess whether site contaminants in groundwater appear to be decreasing in concentration over time, appear to be remaining stable, or are increasing. If groundwater contaminant concentrations do not increase over time, the Navy should request DTSC officially close this site with no further action required, as this will provide confirmation the intrinsic biodegradation processes are adequate to control off-site migration of the contamination.

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LIST OF ACRONYMS AND ABBREVIATIONS

AFCEE	Air Force Center for Environmental Excellence
AL	Action Level
Amwest	Amwest Environmental Engineering
APCL	Applied Physics and Chemistry Laboratory
ASTM	American Society for Testing and Materials
BEHP	bis-2-ethylhexylphthalate
BNI	Bechtel National, Incorporated
bgs	below ground surface
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes (total)
CADHS	California Department of Health Services
CDM Federal	CDM Federal Programs Corporation
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CERFA	Community Environmental Response Facilitation Act
COC	Chain of Custody
COPC	Chemical of Potential Concern
cm/sec	centimeters per second
DCA	Dichloroethane
DI	deciliter
DO	Dissolved Oxygen
DOT	Department of Transportation
DPT	Direct-Push
DQO	Data Quality Objective
DTSC	(California) Department of Toxic Substances Control
EBS	Environmental Baseline Survey
EDD	Electronic Data Deliverable
EPA	United States Environmental Protection Agency
EPC	Exposure Point Concentration
EV	Electron Volt
foc	Fraction of organic carbon
FSP	Field Sampling Plan
°F	Degrees Fahrenheit
ft	feet
GG	Groundwater Grab
GPR	Ground Penetrating Radar

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

HCl	Hydrochloric Acid
HELP	Hydrologic Evaluation of Landfill Performance
HHRA	Human Health Risk Assessment
HI	Hazard Index
HSA	Hollow-Stem Auger
I	Hydraulic Gradient
ID	Identification
IDW	Investigation-Derived Waste
IR	Installation Restoration
J	Estimated Concentration
K	Hydraulic Conductivity
K _d	Soil/Water Partitioning Coefficient
K _{oc}	Organic Carbon Partitioning Coefficient
L	Liter
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LDC	Laboratory Data Consultants
LLNL	Lawrence Livermore National Laboratory
LUFT	Leaking Underground Fuel Tank
MCL	Maximum Contaminant Level
MEK	Methyl Ethyl Ketone
mg/kg	milligrams per kilogram
mg/L	milligrams per Liter
mL	milliliter
MS	Matrix Spike
MSD	Matrix Spike Duplicate
MSL	Mean Sea Level
MTBE	Methyl Tertiary Butyl Ether
MW	Monitoring Well
N	Analyte Identity Uncertain
NA	Not Analyzed
NAVD	National Geodetic Vertical Datum
NCP	National Contingency Plan

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

ND	Not Detected
NE	Screening Level Not Estimated
NEDTS	Naval Environmental Data Transfer Standards
NFESC	Naval Facilities and Engineering Service Center
NMCRC-LA	Naval and Marine Corps Reserve Center-Los Angeles
No.	Number
NPL	National Priority List
OD	Outer Diameter
ORP	Oxygen Reduction Potential
OVM	Organic Vapor Meter
PAH	Polynuclear Aromatic Hydrocarbons
PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability
PCB	Polychlorinated Biphenyl
PCE	Perchloroethylene
PPE	Personal Protective Equipment
PRG	Preliminary Remediation Goal
PVC	Polyvinyl Chloride
PWC	(Navy) Public Works Center
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
R	Rejected data
RSK	Robert S. Kerr Environmental Research Laboratory
RWQCB	(Los Angeles) Regional Water Quality Control Board
SI	Site Inspection
SMCL	Secondary Maximum Contaminate Level
SOP	Standard Operating Procedure
SPLP	Soluble Precipitation Leachate Procedure
SWRCB	State Water Resources Board
STLC	Soluble Threshold Limit Concentration
SVOC	Semivolatile Organic Compound
SWDIV	Southwest Division Naval Facilities Engineering Command

1.0 INTRODUCTION

CDM Federal Programs Corporation (CDM Federal) has prepared this report for the Hazardous Waste Site Inspection (SI) at Installation Restoration (IR) Site 1 at the Naval and Marine Corps Reserve Center-Los Angeles (NMCRC-LA), Los Angeles, California. IR Site 1 consists of a former service station and the vehicle lube rack area. This SI was performed for Southwest Division Naval Facilities Engineering Command (SWDIV) under Contract No. N68711-96-D-2029, Delivery Order Number 024.

CDM Federal performed the SI at IR Site 1 to investigate (1) an underground storage tank (UST) that held gasoline at a former vehicle service station and (2) potential leakage of contents from hazardous waste drums stored at a vehicle lube rack that drained to a former waste oil UST.

The SI is an environmental investigation to assess the nature and extent of potential releases to soil and/or groundwater, assess risk, and recommend possible mitigation alternatives, which include natural remediation (i.e., natural attenuation or intrinsic biodegradation) or no further action (United States Environmental Protection Agency [EPA] 1992).

1.1 SITE DESCRIPTION

The NMCRC-LA is located at 1700 Stadium Way in Los Angeles, California on approximately 6 acres of land, about 1 mile northeast of downtown Los Angeles. Elysian Park surrounds NMCRC-LA to the north, Dodger Stadium is to the northeast, and there is residential housing from the west to southeast. Figure 1-1 shows an area location map, Figure 1-2 presents a vicinity map, Figure 1-3 presents a site map of NMCRC-LA, and Figures 1-4 through 1-7 present site photographs of IR Site 1.

IR Site 1 is located on the middle level of three graded terraces on the property (see Figures 1-3 and 1-7). The vehicle lube rack is located on a rectangular concrete slab approximately 14

feet by 50 feet with an 18-inch wide sump located in the center, running the length of the vehicle lube rack. The remainder of the site is paved with asphalt for parking. The northwestern edge of the slab is approximately 6 feet from the wall of the vehicle maintenance building (Figure 1-3).

1.2 SITE HISTORY

The property history, service station/gasoline UST history, and vehicle lube rack history are discussed below.

1.2.1 Property History

NMCRC-LA, constructed from 1938 to 1940 by the Works Progress Administration, was commissioned in 1940. The mission of NMCRC-LA was to provide administrative, training, and logistics support to reserve units. A large portion of the Administrative Building was remodeled after a fire in 1980. Table 1-1 summarizes the NMCRC-LA history. The NMCRC-LA property has been host to a number of tenants over the years including the Los Angeles Police Department, the Los Angeles City Fire Department, the United States (U.S.) Internal Revenue Service, and the Med Fly Control Unit of the U.S. Department of Agriculture. Currently, no Naval or Marine Corps activities are conducted at NMCRC-LA. Instead, the City of Los Angeles Fire Department currently occupies the site under a lease agreement with the Navy.

1.2.2 Service Station, Gasoline UST

A former service station was built in 1943 and was used for fueling vehicles on-site. The aboveground portion of the service station has been removed.

A gasoline UST was associated with this service station to fuel vehicles. The capacity of the gasoline UST was 1,000 gallons, but the type of tank is unknown (Navy Public Works Center [PWC] 1996). It is assumed that this tank was used exclusively for storage of gasoline. There

are no documents or drawings that describe the location of the gasoline UST or that verify the abandonment or removal of the gasoline UST and its associated piping. It is surmised that the gasoline UST was located between the middle of the wall of the current vehicle maintenance building and the vehicle lube rack concrete slab, running north to just before the containment wall (PWC 1996). A geophysical survey conducted in 1996 to identify the UST was not conclusive because of interference, possibly caused by metal from the vehicle lube rack and from the vehicle maintenance building. The survey did not identify any reflection typical of a UST in the suspected area. The survey did identify a possible excavation area, although the results were not conclusive (PWC 1996).

1.2.3 Vehicle Lube Rack Area

The vehicle lube rack was originally used for vehicle maintenance activities. The lube rack consisted of metal racks for vehicles to drive onto. A submerged pit approximately 3 feet deep, 35 feet long, and 4 feet wide contained a sump that drained directly to a waste oil UST through subsurface piping. Between 1987 and 1989, the site was temporarily used as the Hazardous Waste Storage area (Bechtel National, Incorporated [BNI] 1995). Hazardous substances were stored in 55-gallon drums on the vehicle lube rack and included used oil, solvents, hydraulic fluid, and other new and used vehicle maintenance products. The vehicle lube rack did not have secondary containment, and it was noted in the Environmental Compliance Evaluation performed by the Navy in 1989 that a significant amount of fluids had leaked from these drums (BNI 1995). The vehicle lube rack sump either drained directly to the waste oil UST (PWC 1996) or to an oil water separator.

The waste oil UST was a 2,000-gallon, double-walled steel tank used for storage of used oil from preventative maintenance performed on vehicles (PWC 1996). This waste oil UST was located approximately 10 feet southeast of the vehicle lube rack. The waste oil UST was closed and removed on 9 November 1994 under the supervision of the City of Los Angeles Fire Department. Some of the excavated soil from the tank removal was contaminated with

petroleum products and remediated off-site (Amwest Environmental Engineering [Amwest] 1995).

1.3 PREVIOUS INVESTIGATIONS

Three environmental investigations preceded the SI: removal of a waste oil tank and associated sampling in 1994, an Environmental Baseline Survey (EBS) in 1995, and a subsurface soil investigation in 1996.

1.3.1 Waste Oil UST Removal

A waste oil UST, located 10 feet southeast of the lube rack, was removed in November 1994 (Amwest 1995). Soil samples were collected from two locations below the excavated tank and from two locations in the excavated soil. Results of the sample analyses are presented in Table 1-2. The excavated soil was remediated and properly disposed off-site due to the high levels of total recoverable petroleum hydrocarbons (TRPH) detected in the samples of the excavated soil. TRPH was not detected in the soil samples collected from below the excavation pit; therefore, this soil was left in place (Amwest 1995). For this reason, soil below the waste oil UST was not the focus of the SI.

1.3.2 Environmental Baseline Survey

The 1995 EBS was prepared as the start of the property transfer process under the Navy's Community Environmental Response Facilitation Act (CERFA), which calls for early identification of property suitable for transfer. The EBS concluded that there were two areas at NMCRC-LA categorized as Type 7 (areas that are unevaluated or require additional evaluation): (1) the vehicle lube rack area because "hazardous materials formerly stored in the Lube Rack Area could have potentially been released into the subsurface from past storage practices" and (2) Former UST and service station because there was no confirmation that the UST had been removed (BNI 1995). These two areas are the focus of this SI and report. One

other area was categorized as Type 7: the Small Arms Firing Range in the Administration Building Basement, but this area was not part of this SI.

1.3.3 Subsurface Soil Investigation

A geophysical survey and subsurface soil sampling were performed in late 1995 and 1996 by the Navy Public Works Center (PWC).

1.3.3.1 Geophysical Survey

A geophysical survey was performed on 27 December 1995 to identify the location of the UST (or its former location if it had been removed). The geophysical survey consisted of a ground penetrating radar (GPR) survey near the lube rack. A typical reflection of a UST was not detected; however, indications of soil disturbance between the lube rack and vehicle maintenance building suggest that excavation may have occurred. Overall, the results were not conclusive whether the UST has been removed (PWC 1996, see Appendix M).

1.3.3.2 Soil Sampling

Following the geophysical survey, soil samples were collected in 1996 by direct push (DP) methods at five boring locations in and around the lube rack (see Figure 1-8). Samples were collected at different depths at each boring location, ranging from 2 to 19 feet below ground surface (bgs) (see Table 1-3). All soil samples were analyzed for the following:

- Total petroleum hydrocarbons (TPH) by the California Department of Health Services (CADHS) Leaking Underground Fuel Tank (LUFT) method (i.e., U.S. EPA Method 8015 Modified);
- TRPH by EPA Method 418.1;
- Benzene, toluene, ethylbenzene, and total xylenes (BTEX) by EPA Method 8020;
- Volatile halogenated hydrocarbons by EPA Method 8010; and
- Organic lead by the California LUFT Method.

Table 1-3 summarizes the concentrations of the detected analytes in the soil samples.

Results of the soil sample analyses indicated the following (PWC 1996):

- Gasoline and BTEX were detected adjacent to the vehicle lube rack to a depth of 19 feet bgs and beneath the vehicle lube rack at 11 feet bgs. At 2 feet bgs, 1,2-dichloroethane was detected beneath and adjacent to the vehicle lube rack.
- The detected concentration of TRPH found at 2 feet bgs may be from the asphalt parking lot.
- Gasoline and BTEX detected in soil boring SB-3 confirmed a release from the gasoline UST at the former service station.
- Since groundwater was not encountered in the deepest soil boring (19 feet bgs), it was unknown if groundwater had been impacted by the leaking gasoline UST.

The volatile halogenated hydrocarbon 1,2-dichloroethane (1,2-DCA) was detected in two samples, at depths of 2 and 9 feet bgs; in both cases, it was not detected in samples collected at depths 2 to 3 feet deeper than these two samples. 1,2-DCA may be present as a result of its former use as a gasoline additive (SWRCB 1987 and EPA 1992b).

Soil samples collected between the lube rack and building indicated gasoline contamination, with the deepest sample showing the highest concentrations of TPH and BTEX. The 1996 Subsurface Soil Investigation Report recommended that several more borings be conducted to further assess the extent of contamination and that a monitoring well be installed to allow assessment of potential impacts to groundwater (PWC 1996).

1.4 PROJECT PURPOSE AND OBJECTIVES

CDM Federal performed an SI in 1999-2000 at IR Site 1 to investigate the following potential sources of contamination:

- Potential leakage from a UST that held gasoline at the former service station;
and

- Potential leakage of contents from hazardous waste drums stored at the vehicle lube rack that most likely drained to a waste oil UST.

These two areas have been investigated together because they are located adjacent to each other. Because the waste oil UST most likely received wastes from the leaking drums noted in 1988 and because the waste oil UST and surrounding soil were removed in 1994, the gasoline UST was considered the primary source of potential waste releases.

The SI was performed in accordance with the following guidance documents:

- The EPA *Guidance for Performing Site Inspections under CERCLA*, EPA/540/R-92/021, dated September 1992 (EPA 1992);
- *Navy/Marine Corps Installation Restoration Manual*, dated February 1997 (Naval Facilities Engineering Command 1997);
- CDM Federal *Work Plan for Site Inspection at Installation Restoration Site 1, Naval and Marine Corps Reserve Center, Los Angeles, California*, dated October 1999;
- CDM Federal *Work Plan Addendum No. 1 for Site Inspection at Installation Restoration Site 1, Naval and Marine Corps Reserve Center, Los Angeles, California*, dated January 2000; and
- EPA *Risk Assessment Guidance for Superfund (RAGS), Volume I Human Health Evaluation Manual*, EPA/540/1-89/002, dated December 1989.

The California Department of Toxic Substances Control (DTSC) is the lead regulatory agency for this project because IR Site 1 is considered a Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) site. The Los Angeles Regional Water Quality Control Board (RWQCB) issued a closure letter in 1998 for the gasoline and the waste oil USTs and will become involved only if they desire involvement after reviewing this report. The RWQCB closure letter stipulates that closure is based on the assumption that there is no other contamination than what was already identified by 1998. See Appendix N for a copy of the RWQCB letter.

1.5 REPORT ORGANIZATION

The report is organized as identified below:

- 1.0 **Introduction:** Summary information on the site description, site history, previous investigations, project purpose and objectives, and report organization.
- 2.0 **Physical Characteristics of Study Area:** Description of topography, geology, hydrogeology, existing biological conditions, and land use of the study area and surroundings.
- 3.0 **Site Investigation Activities:** Description of procedures used for the geophysical survey, the soil investigation, the groundwater investigation, land surveying, investigation-derived waste management, sample handling and management, laboratory analysis, decontamination procedures, quality control, and data management.
- 4.0 **Soil and Groundwater Investigation Findings:** Discussion of site hydrogeology, groundwater gradient and flow conditions, background metals assessment, and results of soil and groundwater analyses.
- 5.0 **Quality Assurance/Quality Control (QA/QC):** Summarizes adherence to field procedures, results of field QC sample analysis, data validation findings, and overall data quality.
- 6.0 **Contamination Fate and Transport:** Description of chemical mobility of contaminants, potential contaminant pathways, and soil physical properties; groundwater flow and transport modeling results; potential for petroleum hydrocarbons to naturally biodegrade; and conclusions about the contaminant fate and transport.
- 7.0 **Human Health Risk Assessment:** Quantitative human health risk assessment (HHRA) methodologies, identification of chemicals of potential concern, exposure scenarios and parameters, and results using future scenarios for receptors and pathways.
- 8.0 **Conclusions and Recommendations:** Summary of information gathered during the SI and conclusions based on this information.
- 9.0 **References**

The following appendices are attached (Appendix O is in Volume 2):

Appendix A	Geophysical Survey Report
Appendix B	Soil Boring Logs
Appendix C	Geotechnical Laboratory Reports
Appendix D	Well Construction Logs
Appendix E	Groundwater Sampling Logs
Appendix F	Land Surveying Reports

Appendix G	Screening Criteria
Appendix H	Sampling and Analysis Matrix
Appendix I	Field QC Sample Results
Appendix J	Background Metals Assessment
Appendix K	Fate and Transport Documentation
Appendix L	Human Health Risk Assessment Documentation
Appendix M	Excerpts from Historical Documents
Appendix N	Regulatory Agency Letters/Comments and Navy Responses
Appendix O	Data Validation Reports

Table 1-1
Historical Summary of NMCRC-LA

Time Period	Historical Activity
1938 to 1940	NMCRC-LA constructed.
1940	NMCRC-LA commissioned.
1943	Service Station constructed.
Late 1970s	Service Station demolished. Gasoline UST reportedly removed during the demolition.
1980	Fire at the Administration Building.
1987 to 1989	Vehicle Lube Rack used as storage area for hazardous substances.
1994	Waste oil UST removed.
1995	Environmental Baseline Survey performed at NMCRC-LA, identifying the need for further investigation of the former service station and the vehicle lube rack.
1996	Subsurface soil investigation performed at IR Site 1. Petroleum products and volatile organic compounds detected. Removal of gasoline tank unverifiable by geophysical survey.
1999 to 2000	Site Inspection performed to investigate IR Site 1.

Notes:

IR = Installation Restoration
NMCRC-LA = Naval and Marine Corps Reserve Center-Los Angeles
UST = underground storage tank

Table 1-2
Analytical Results From Soil Samples Collected Following Waste Oil Tank Removal, 1994

Sample Number	Description	TRPH (mg/kg)	Benzene (µg/kg)	Toluene (µg/kg)	Ethyl Benzene (µg/kg)	Xylenes (total) (µg/kg)
SP-1	Soil pile	7440	49.9	ND	ND	ND
SP-2	Soil pile	1660	29.8	ND	ND	ND
SO-1	South of UST, 13 feet bgs	ND	13.6	ND	ND	ND
NO-2	North of UST, 13 feet bgs	ND	30.7	ND	ND	ND

Notes:

ND = Not Detected. For benzene, toluene and ethylbenzene, ND < 5 µg/kg. For total xylenes, ND < 15 µg/kg. For TRPH ND < 10 mg/kg.

Benzene, toluene, ethylbenzene, and total xylenes analyzed by EPA Method 8020

TRPH = Total recoverable petroleum hydrocarbons by EPA Method 418.1.

UST = underground storage tank

bgs = below ground surface

mg/kg = milligrams per kilogram

µg/kg = micrograms per kilogram

Source: *Tank Closure Report*, Amwest Environmental Engineering, February 1995

Table 1-3
Analytical Results From Soil Samples Collected In 1996

Boring Number	Boring Depth (In Feet)	IRPH	IPH Gasoline	IPH Diesel	Benzene	Toluene	Ethyl Benzene	Xylenes (total)	1,2-Dichloroethane
SB-4	2	778	ND	ND	ND	ND	ND	ND	ND
SB-4	5	ND	ND	ND	ND	ND	ND	ND	ND
SB-5	2	50	ND	ND	ND	ND	ND	ND	ND
SB-5	5	ND	ND	ND	ND	ND	ND	ND	ND
SB-5	10	ND	ND	ND	ND	ND	ND	ND	ND
SB-1SA	6	ND	ND	ND	ND	ND	ND	ND	ND
SB-1SA	9	ND	ND	ND	ND	ND	ND	ND	0.0181
SB-1SA	11	32	24	ND	0.075	0.028	0.172	0.535	ND
SB-2	2	2.845	ND	ND	ND	ND	ND	ND	ND
SB-2	5	ND	ND	ND	ND	ND	ND	ND	ND
SB-3	2	1,088	368	ND	0.503	0.364	1.643	2.634	0.0062
SB-3	5	258	327	ND	1.9	0.7	4.9	20.6	ND
SB-3	10	883	1,447	ND	4.2	35.3	17	106	ND
SB-3	13	1,100	1,164	ND	4.0	59	28	162	ND
SB-3	19	2,642	3,760	ND	7.0	111	73	371	ND
Residential Preliminary Remediation Goal		None	None	None	0.63	790	230	320	0.25
Industrial Preliminary Remediation Goal		None	None	None	1.4	880	230	320	0.55

Notes:

All results are in milligrams per kilogram (mg/kg)

Those results in **boldface** exceed both the residential and industrial preliminary remediation goals.

ND = Not Detected. For benzene, toluene, ethylbenzene, and 1,2-dichloroethane, ND < 0.005 mg/kg. For total xylenes, ND < 0.015 mg/kg

IPH = Total petroleum hydrocarbons by California Department of Health Services Leaking Underground Fuel Tank EPA Method 8015 Modified

IRPH = Total recoverable petroleum hydrocarbons by EPA Method 418.1

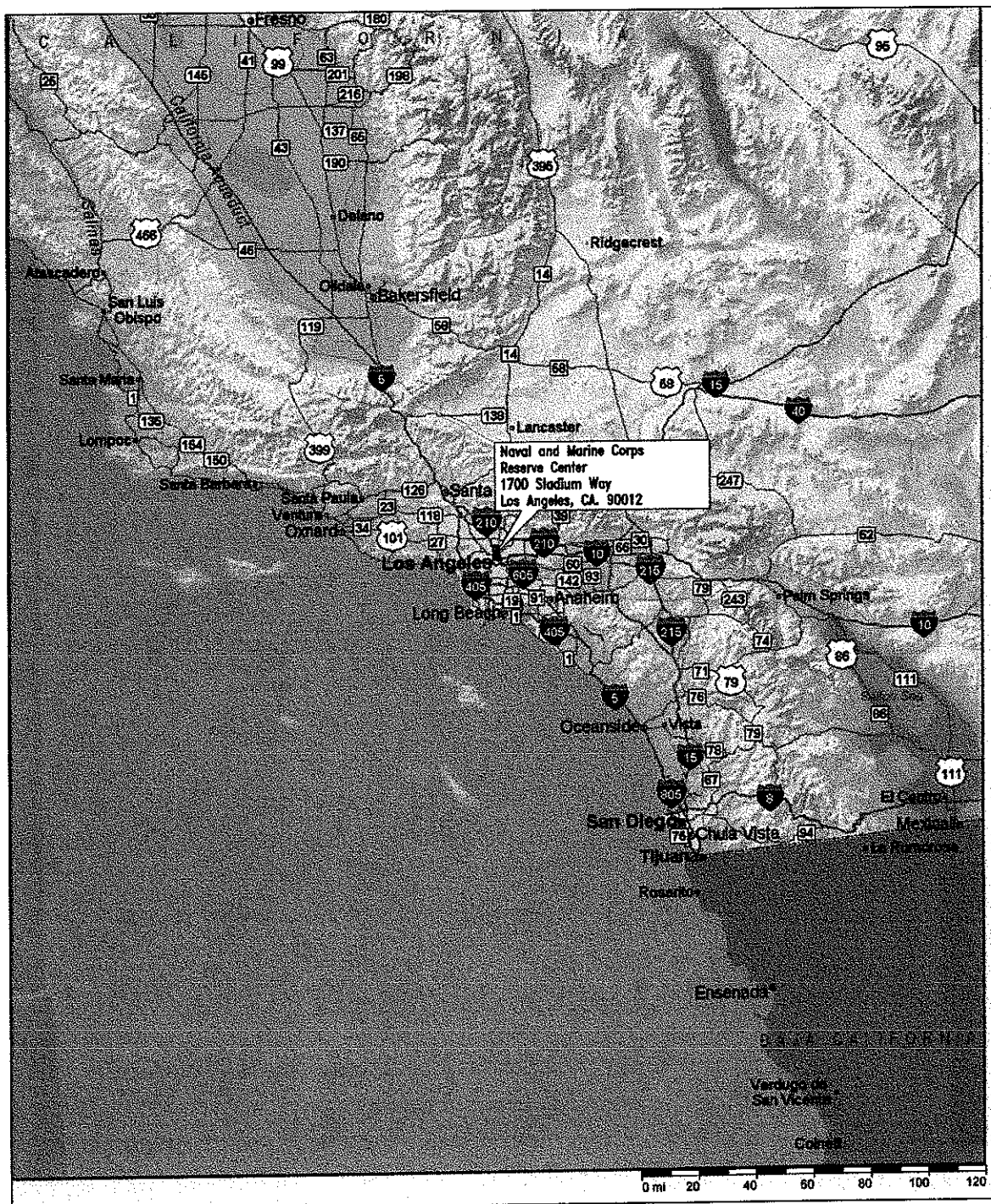
1,2-Dichloroethane was detected by EPA Method 8010. All other analytes from EPA Method 8010 were not detected.

Benzene, toluene, ethylbenzene, and total xylenes were detected by EPA Method 8020 (modified to apply to soil).

Residential and Industrial Preliminary Remediation Goal levels are taken from EPA Region IX Preliminary Remediation Goals, October 1, 1999.

Source: *Subsurface Soil Investigation Report*, Navy Public Works Center, September 1996.

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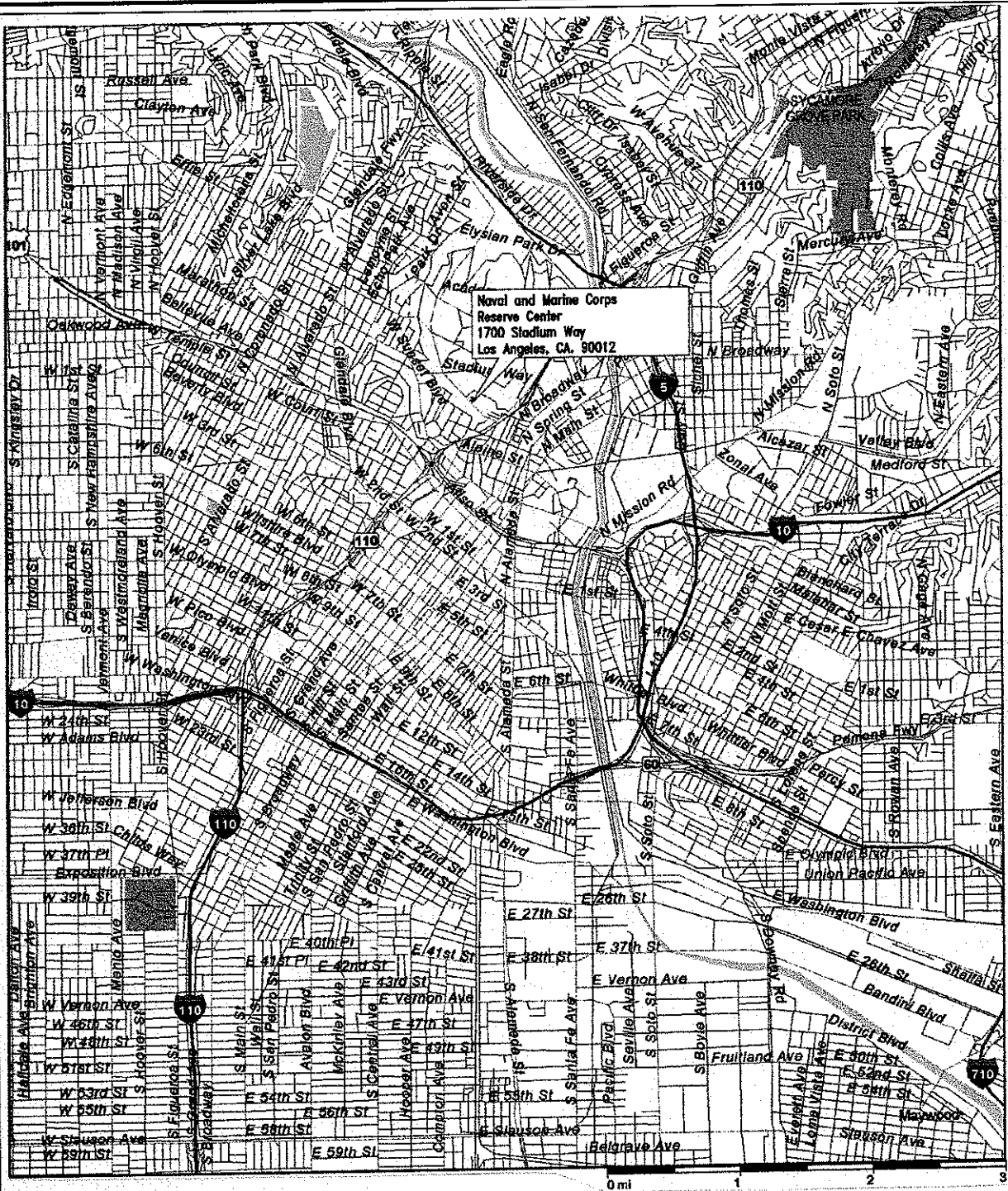


**FIGURE 1-1
AREA LOCATION MAP**

NAVAL AND MARINE CORPS RESERVE CENTER

CDM Federal Programs Corporation
A Subsidiary Of Camp Dresser & McKee Inc.

DATE: 12/2000
FILE NO.: 024_1-1
DO NO.: 6210-024

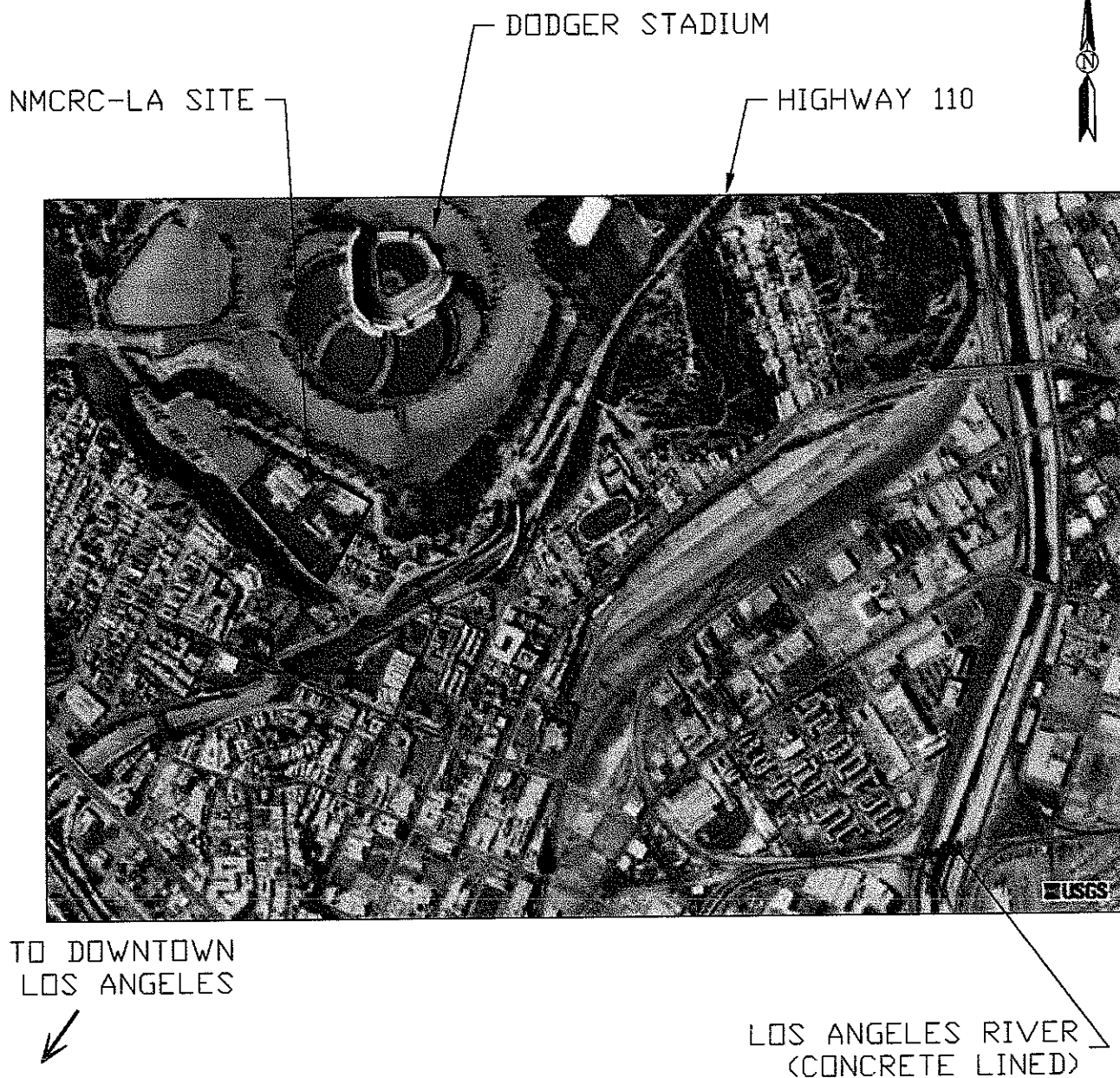


**FIGURE 1-2
VICINITY MAP**

NAVAL AND MARINE CORPS RESERVE CENTER

CDM Federal Programs Corporation
A Subsidiary of Camp Dresser & McKee Inc.

DATE: 12/2000
FILE NO.: 024.1-2
DO NO.: 6210-024



SOURCE: USGS, 22 AUG 1989

0 500 1000 1500

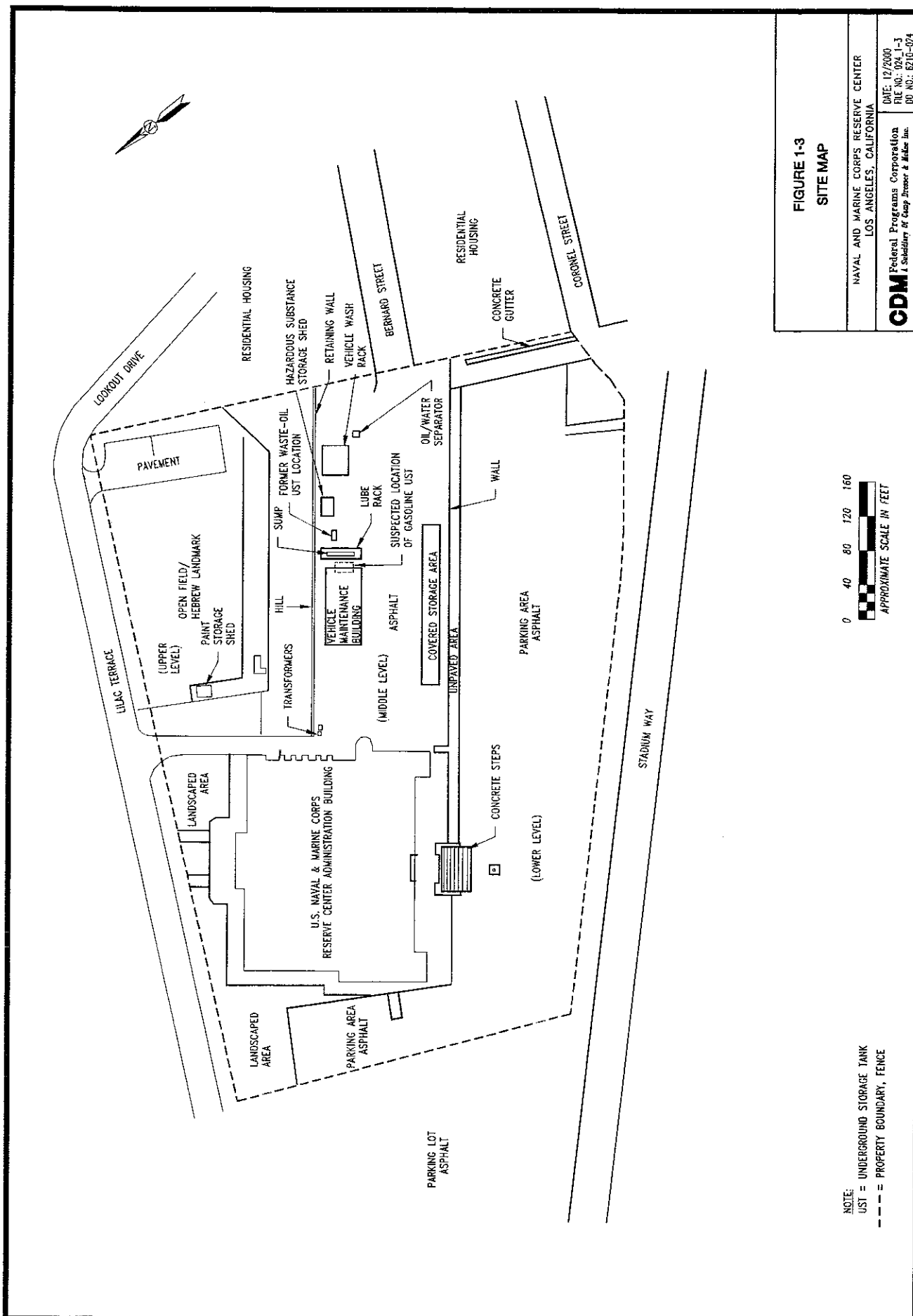
APPROXIMATE SCALE IN FEET
1"=1320 ft

FIGURE 2-1
AERIAL PHOTOGRAPH OF NMCRC-LA SITE
AND SURROUNDINGS

NAVAL AND MARINE CORPS RESERVE CENTER

CDM Federal Programs Corporation
A Subsidiary Of Camp Dresser & McKee Inc.

DATE: 12/2000
FILE NO.: 024_2-1
DO NO.: 6210-024



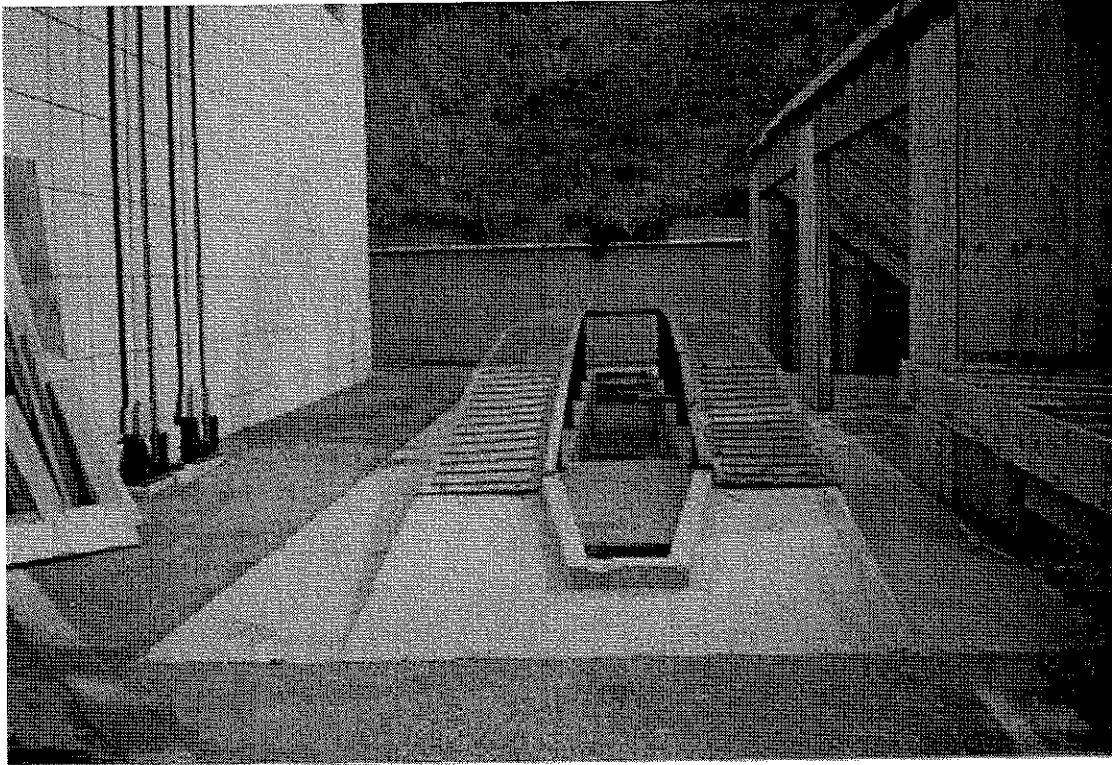


Figure 1-4 Vehicle lube rack

05/07/98

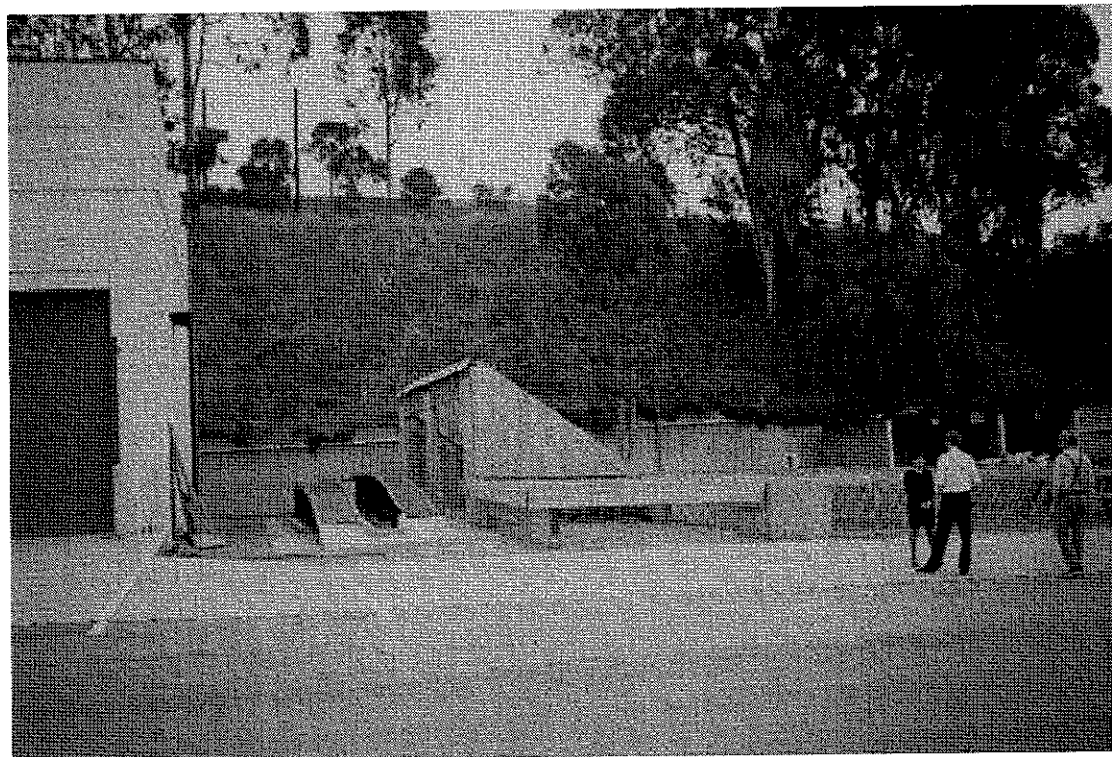


Figure 1-5 NMCRC-LA Site

05/07/98

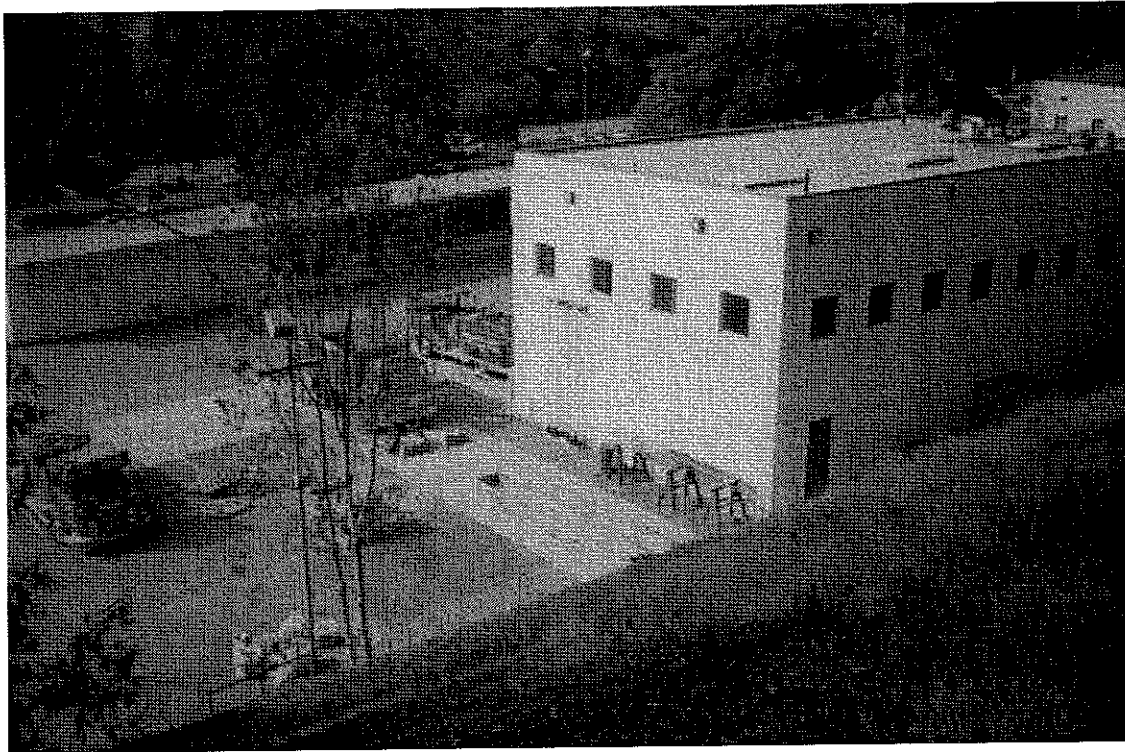


Figure 1-6 Vehicle lube rack (center)
Vehicle maintenance building (right)

Facing west
01/24/00

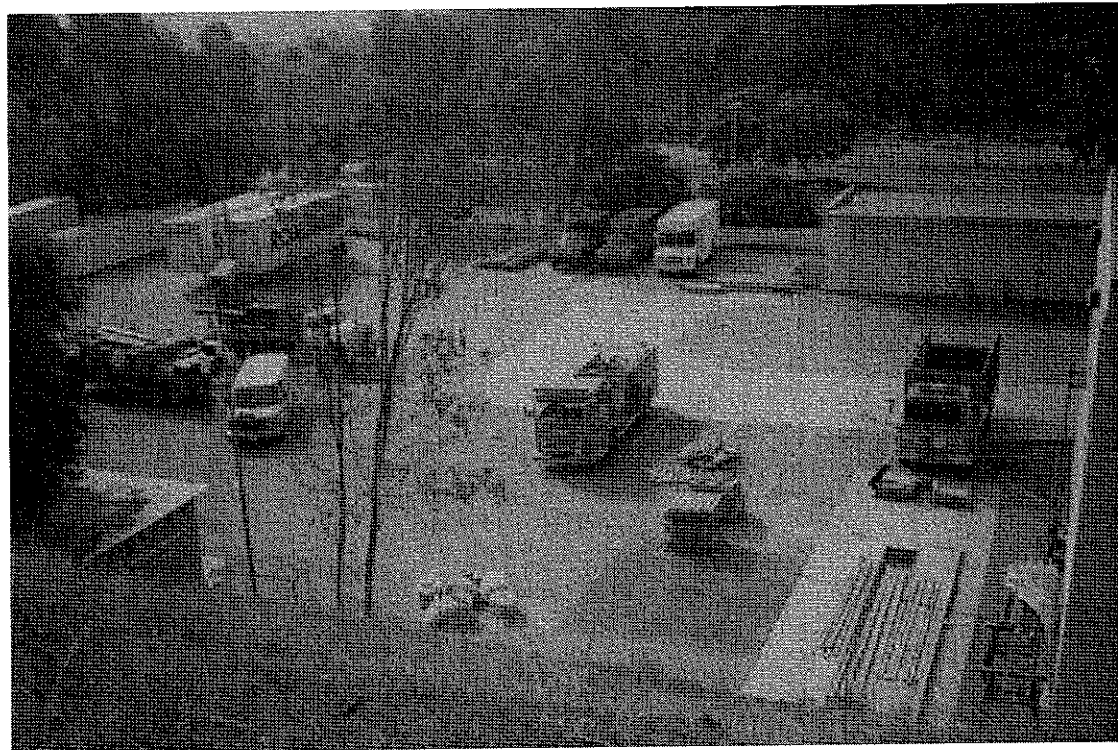
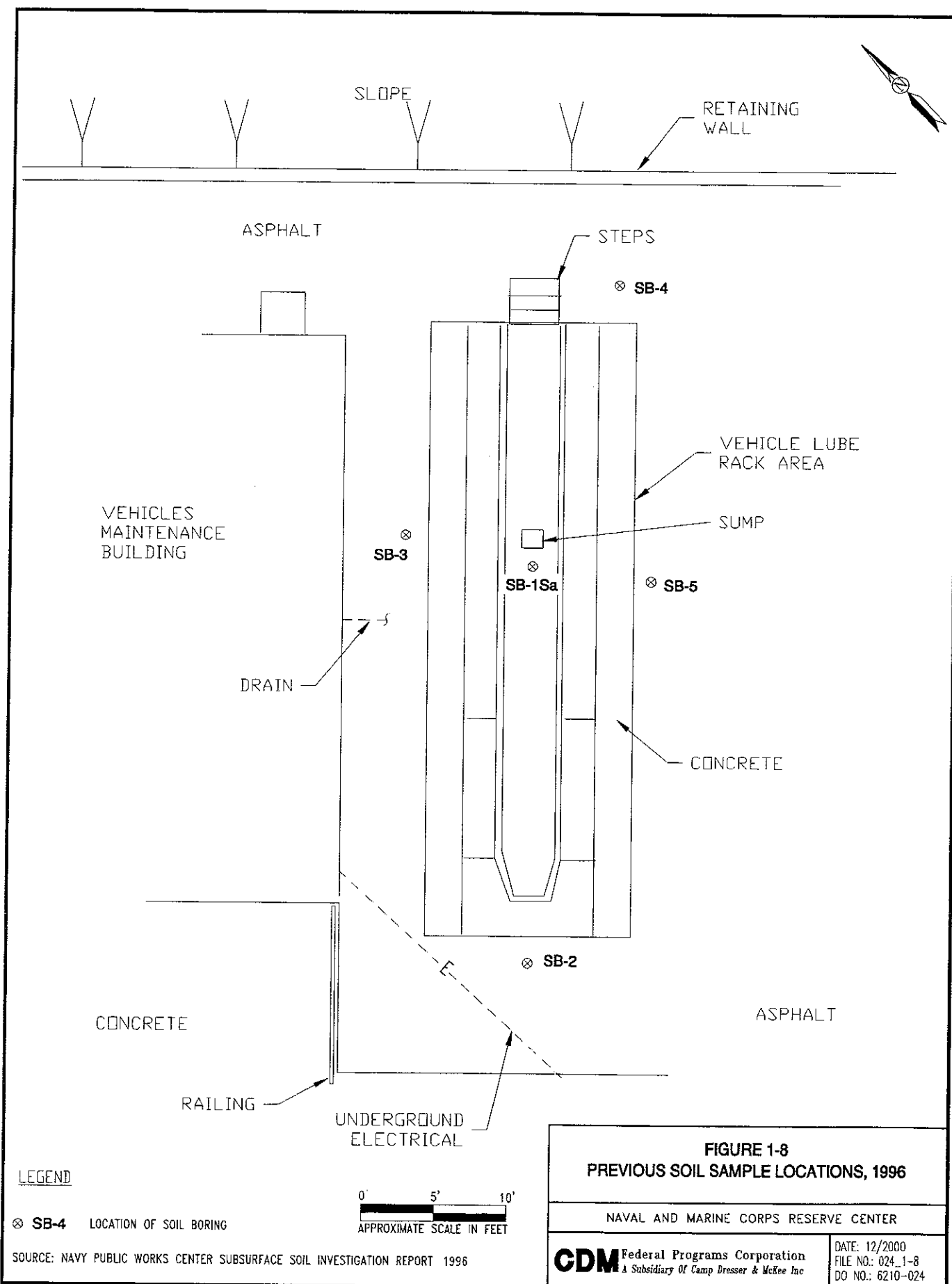


Figure 1-7 Vehicle lube rack (bottom right)

Facing southwest
01/24/00



2.0 PHYSICAL CHARACTERISTICS OF STUDY AREA

The physical characteristics of the study area, including topography, geology and soils, hydrogeology, existing biological conditions, and land use are discussed below. Information in this section was obtained from *The Community Environmental Response Facilitation Act (CERFA) Environmental Baseline Survey for Naval and Marine Corps Reserve Center* (BNI 1995) and supplemented by site observations, unless otherwise referenced.

2.1 TOPOGRAPHY

NMCRC-LA is located in Chavez Ravine, in the hilly terrain of Elysian Hills. These hills are bounded by the Santa Monica Mountains to the north and west, the Los Angeles Narrows and Repetto Hills to the east, and the eastern margin of the central block of the Los Angeles Basin to the south (BNI 1995).

The lube rack area is located at an elevation of approximately 400 feet above mean sea level. IR Site 1 is located on the middle level of three graded terraces on the property (see Figures 1-3 and 1-7). Because of these engineered terraces at NMCRC-LA, elevation on-site ranges from approximately 380 feet to 450 feet above mean sea level. A large hill is located immediately to the northeast of the lube rack area (see Figures 1-3, 1-5, 1-6, and 1-7). The surrounding hills within a mile of the site are situated approximately 700 feet above mean sea level. See Appendix M for a topographical map of NMCRC-LA from the 1995 EBS.

2.2 GEOLOGY AND SOILS

Continued movement of the Elysian Hills anticline, which is located on the southerly side of the Los Angeles Narrows, may have caused the "reverse gradient" on the base of the water-bearing series in the Los Angeles Narrows area (State Water Rights Board 1962). The NMCRC-LA is underlain by a thin layer of sand and clay from the Quaternary alluvium, which is underlain by sandstone with minor amounts of shale from the Miocene Epoch Topanga and Puente formations. Both of these formations are steeply tilted and dip to the

south. The Quaternary sediments result from erosion from the top of canyon. During the waste oil UST excavation, the subsurface investigation, and the SI, site observations were consistent with these findings.

2.3 HYDROGEOLOGY

The NMCRC-LA is located adjacent to the mouth of the Los Angeles Narrows, where the Los Angeles River enters the Los Angeles Forebay area of the Central Groundwater Basin. Results of numerous groundwater investigations within a one-mile radius of NMCRC-LA on file with the Los Angeles RWQCB indicate that the groundwater flow is to the south. South of the site, the depth to groundwater is approximately 17 feet to 25 feet bgs (BNI 1995), but at NMCRC-LA, the depth to groundwater is deeper because of its location in the hills. Groundwater was identified at a depth of approximately 30 feet bgs during the SI. Because of the pressure head, the water level rose to approximately 24 feet bgs in the wells installed during the SI.

Appendix B contains site specific boring logs prepared for this SI.

There are no known potable or industrial water supply wells located within a one-mile radius of NMCRC-LA. The nearest known potable water wells are located three miles north of the site near the intersection of Casitas Avenue and Fletcher Drive (production wells OS13W04-L03 and OS13W04-K01) and near the intersection of the Glendale Freeway and Interstate 5 (production well OS13W04-L02).

The groundwater flow direction calculated based on water levels measured in the wells during the SI, is to the southeast (see Figure 4-3).

Groundwater quality based on general water chemistry results from water samples collected during the SI indicate that the groundwater is generally not very suitable for drinking water purposes (see Section 4.5.6). However, the RWQCB considers all groundwater in the LA Basin as potential drinking water.

2.4 SURFACE WATER

The vehicle lube rack area is flat and is surrounded by an asphalt-paved area that slopes towards the southeastern area of the site near Bernard Street. Because the area is paved, rainwater drains toward the storm drains. Rain falling on the concrete slab of the vehicle lube rack drains into the sump. The sump discharged to the waste oil UST that was removed in 1994.

The nearest surface water body is the concrete-lined Los Angeles River, approximately 1.0 mile to the east (see Figure 2-1).

2.5 EXISTING BIOLOGICAL CONDITIONS

DTSC ecological scoping assessment guidance states that potential ecological receptors should be identified. NMCRC-LA is almost entirely paved, and all areas of the property have been disturbed. NMCRC-LA has little natural vegetation present. The majority of vegetation on-site consists of ornamental grasses, shrubs, and trees used for landscape purposes. Because of the highly developed condition of the site, no potential for sensitive plant species exists. According to the EBS, no threatened or endangered species were encountered (BNI 1995).

2.6 LAND USE

Figures 2-1 and 2-2 show aerial photographs that indicate general land use of the NMCRC-LA site surroundings. The majority of the area is urban, except for Elysian Park to the north and Dodger Stadium to the northeast. Highway 110 is located approximately 0.25 miles east of NMCRC-LA. Downtown Los Angeles is located approximately 1 mile southwest of NMCRC-LA. The surrounding urban area consists mostly of residential areas with schools, a medical center, and interspersed areas of business and commercial areas (see Figure 2-3 for a photograph of the site and surrounding area). The nearest residential area is immediately southeast of the site (see Figure 2-4).

2.7 CLIMATE

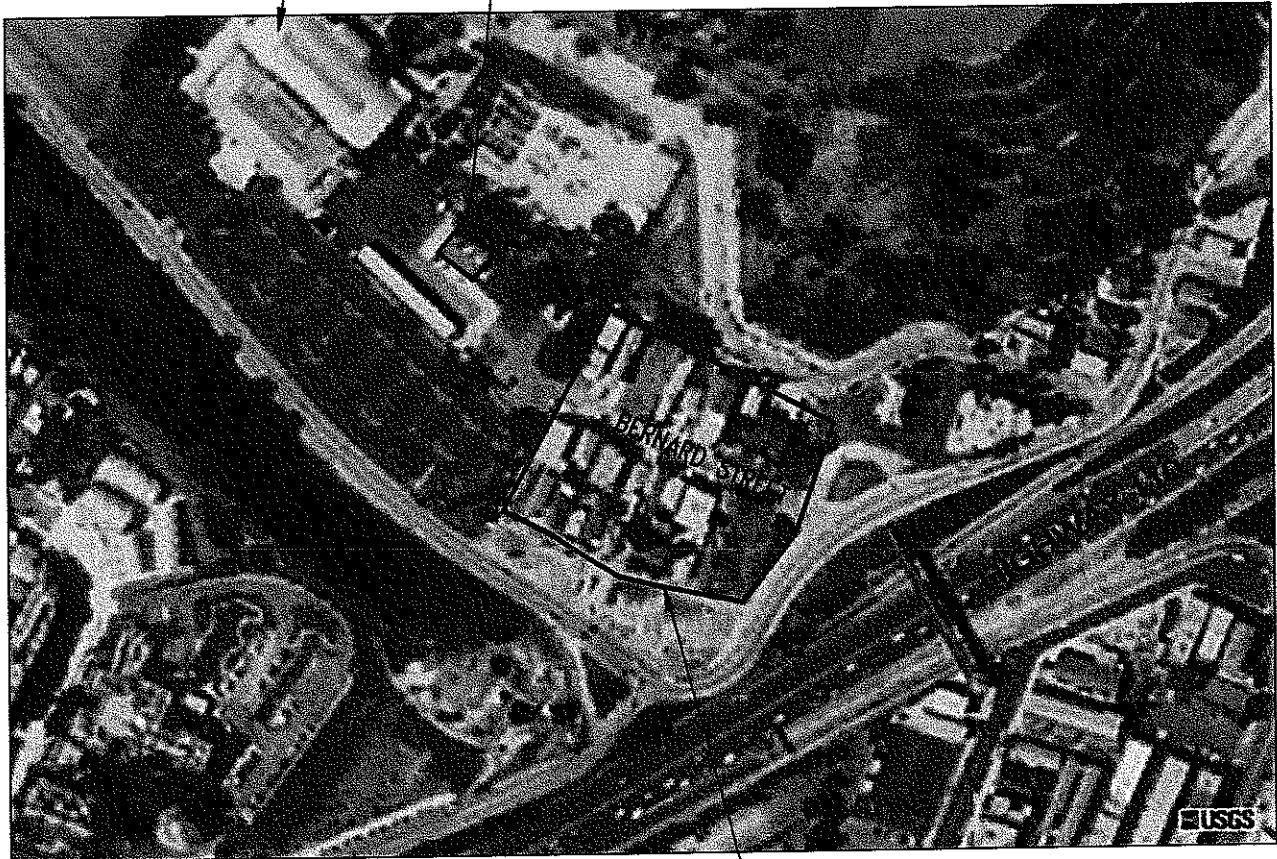
The local climate is semiarid, characterized by mild winters and warm summers. Mean monthly temperatures (30-year average) range from a low of 58 degrees Fahrenheit (°F) in January to a high of 74°F in August. Annual precipitation averages 14.6 inches, also based on a 30-year average (Western Region Climate Center 1997). Most precipitation typically occurs from November through March. Relative humidity ranges from 50 to 80 percent annually. In the late fall and early winter months, gusty northeasterly (or "Santa Ana") winds may occur.

2.8 SITE CONCEPTUAL MODEL

The site conceptual model identifies the exposure setting from IR Site 1 to present an overall evaluation of sources, transport mechanisms, receptors, exposure points, and exposure routes. Figure 2-5 and Figure 2-6 presents a current scenario and a future scenario, respectively.

NMCRC-LA
ADMINISTRATION
BUILDING

VEHICLE MAINTENANCE
BUILDING



RESIDENTIAL AREA

SOURCE: USGS, 22 AUG 1989

0 100 200 300
APPROXIMATE SCALE IN FEET
1"=330 ft

**FIGURE 2-2
AERIAL PHOTOGRAPH OF NMCRC-LA SITE
AND IMMEDIATE VICINITY**

NAVAL AND MARINE CORPS RESERVE CENTER

CDM Federal Programs Corporation
A Subsidiary Of Camp Dresser & McKee Inc.

DATE: 12/2000
FILE NO.: 024_2-2
DO NO.: 6210-024



Figure 2-3 NMCRC-LA site and vicinity

Facing east
01/24/00

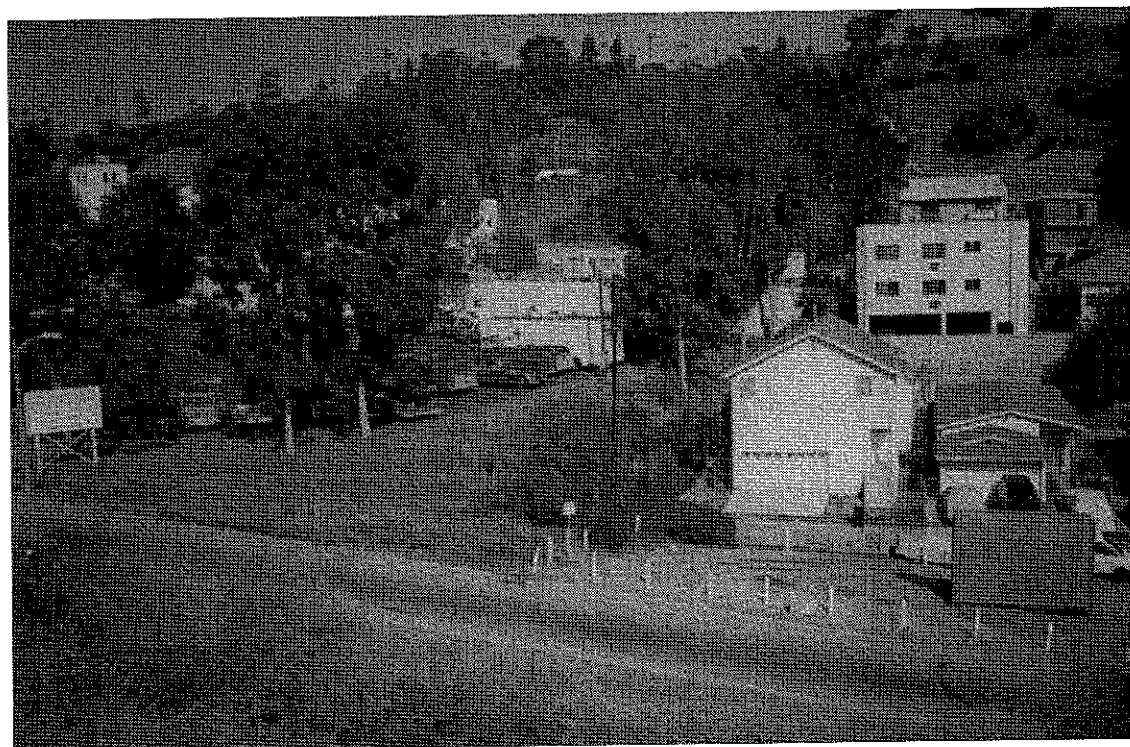
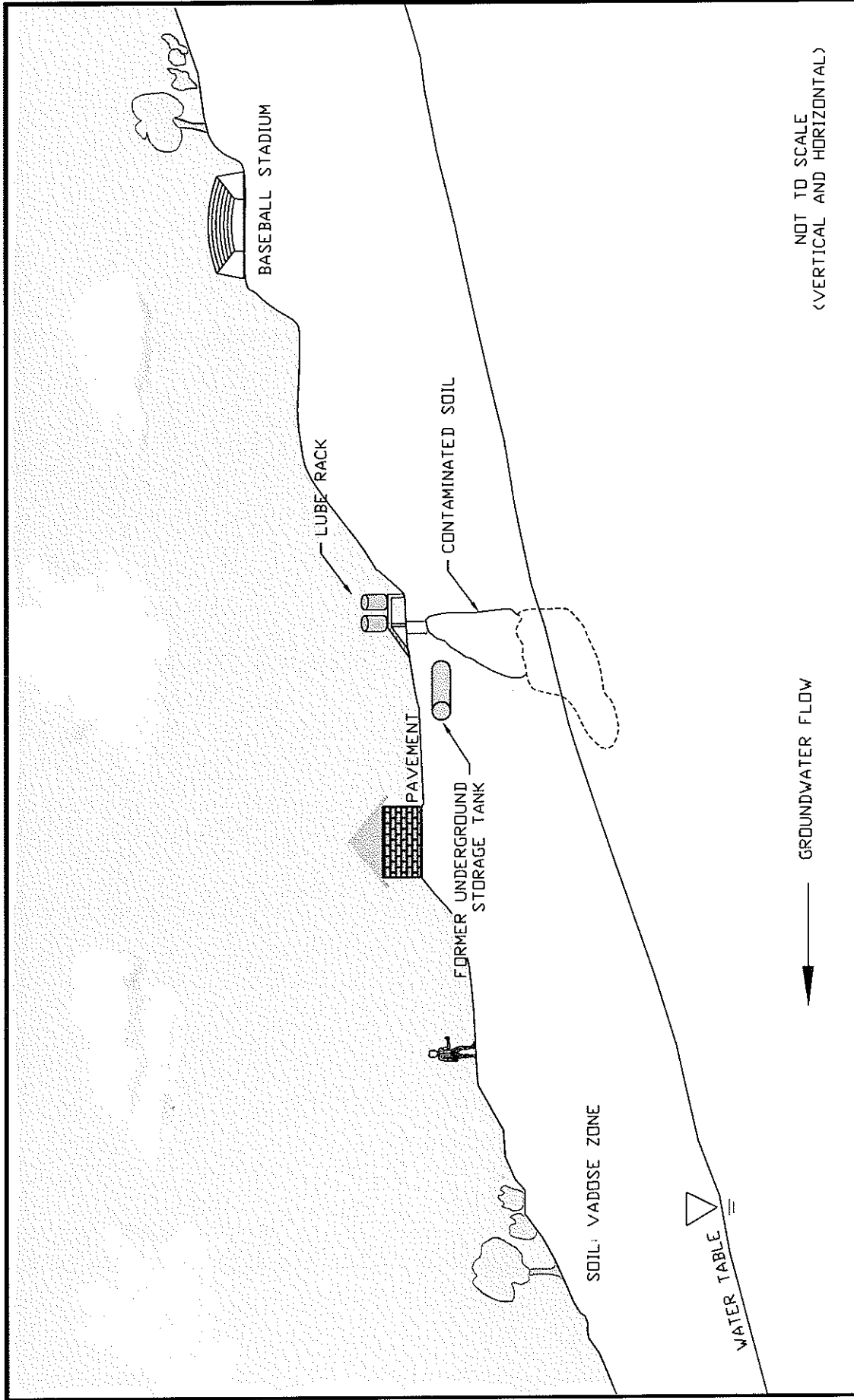
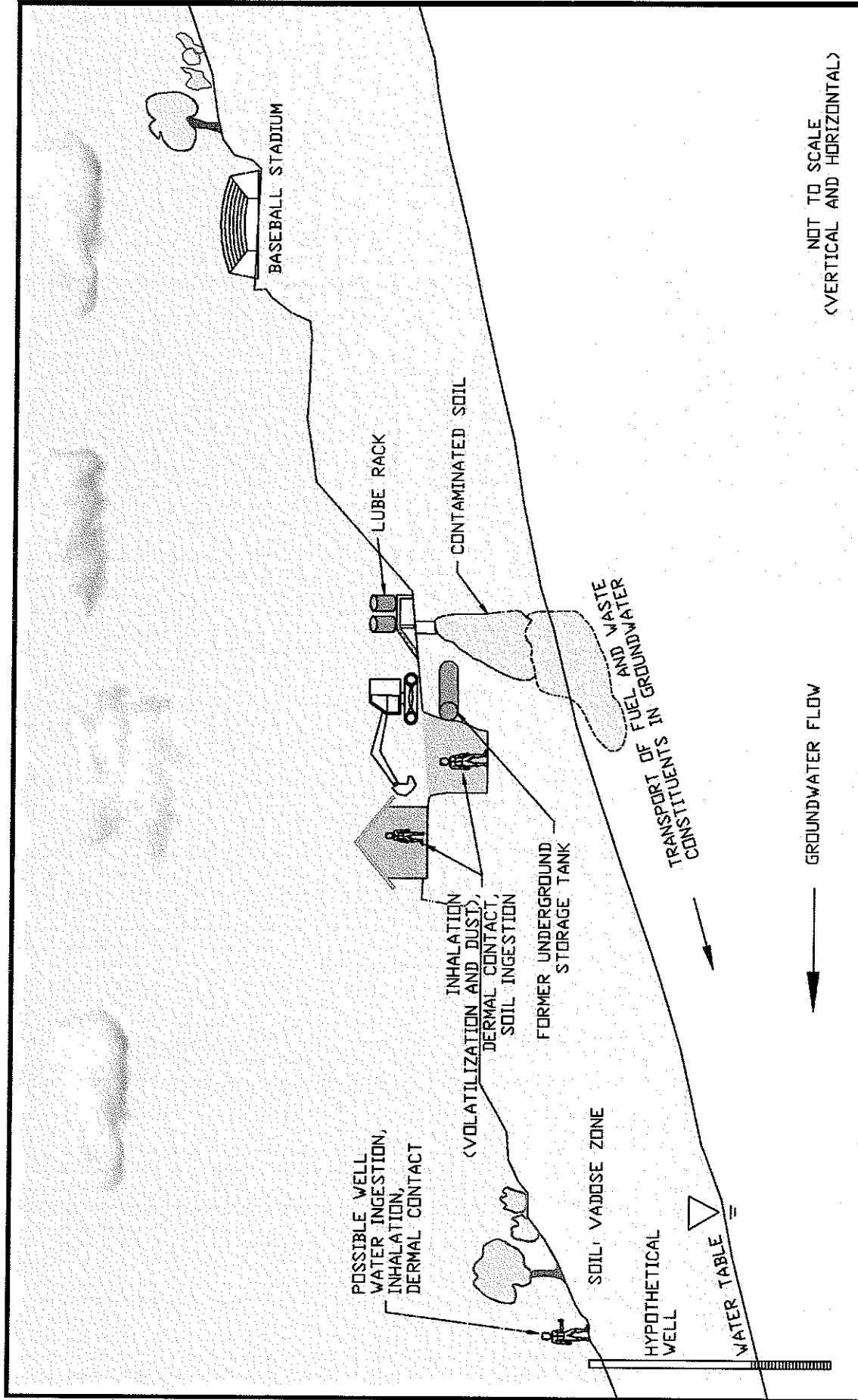


Figure 2-4 NMCRC-LA site (left), Residential area (right)

Facing northeast
01/24/00



NAVAL AND MARINE CORPS RESERVE CENTER LOS ANGELES, CALIFORNIA		Site Conceptual Model Current Scenario		FIGURE 2-5
CDM Federal Programs Corporation A Subsidiary Of Camp Dresser & McKee Inc.	DATE: 12/2000 FN: 024_2-5			
	MODIFIED BY: J. Brown		PROJECT NO. 6210-024	



NAVAL AND MARINE CORPS RESERVE CENTER LOS ANGELES, CALIFORNIA		Site Conceptual Model Possible Future Scenario		FIGURE
CDM Federal Programs Corporation A Subsidiary of Camp Dresser & McKee Inc.		DATE: 12/2000 FN: 024_2-6		2-6
MODIFIED BY: J. Brown		PROJECT NO: 6210-024		

3.0 SITE INVESTIGATION ACTIVITIES

The following section contains descriptions of procedures used for the geophysical survey, the soil investigation, the groundwater investigation, land surveying, investigation-derived waste management, sample handling and management, field quality control, decontamination procedures, laboratory analysis, data validation, and data management.

The investigation was accomplished using a two-phased approach so that the full extent of contamination could be efficiently delineated. This approach allowed for assessment of the first phase of analytical results, followed by strategic placement of the second phase samples. In this way, the site was characterized by collecting a minimal amount of samples.

Phase I: Phase I was performed from 27 October to 16 November 1999. The primary objectives of Phase I were the following:

- Identify the depth to groundwater;
- Identify the location of the gasoline UST (geophysical survey);
- Confirm the presence of soil contamination from IR Site 1;
- Assess the extent (both lateral and vertical) of contamination;
- Assess if groundwater has been impacted by IR Site 1;
- Assess the groundwater gradient; and
- Assess background concentrations of metals in soil and groundwater.

Phase I used hollow-stem auger (HSA) drilling to collect soil samples, to install five groundwater monitoring wells (three of which were used for background samples) for groundwater sampling, and to install three temporary piezometers for groundwater grab sampling. A total of four additional borings were completed for soil sample collection and were used as background samples for assessing background levels.

Phase II: The objective of Phase II was to use the results from Phase I soil and groundwater samples to identify locations for additional soil and groundwater sampling to further evaluate the extent of contamination. Phase II included nine additional groundwater samples (two from newly installed monitoring wells, four from temporary piezometers [see Section 3.3]), and three from the Phase I monitoring wells to confirm results identified from the Phase I samples. Soil samples were also collected from these six soil borings conducted during Phase II. *Work Plan Addendum No. 1* (CDM Federal 2000), approved by DTSC prior to beginning Phase II, described in detail the planned locations and rationale for Phase II soil and groundwater sampling.

Originally, three phases of field work were planned (CDM Federal 1999); however, sufficient data were available after Phase I to allow Phases II and III to be combined (CDM Federal 2000).

3.1 GEOPHYSICAL SURVEY

A geophysical survey was performed for the following two reasons:

- Search for subsurface utility lines to clear soil boring locations for drilling; and
- Search for the gasoline UST from the former service station to assess if the gasoline UST has been removed.

The geophysical survey was performed by an approved licensed subcontractor, Spectrum E.S.I. of San Fernando, California. Techniques used included ground-penetrating radar, metal detection, and electromagnetic detection. The geophysical survey for Phase I was performed 27 October 1999, while the geophysical survey for Phase II (subsurface utility line clearance only) was performed 24 January 2000.

3.1.1 Subsurface Utility Clearance

A geophysical survey was performed at all proposed soil boring locations to clear for subsurface utilities on 27 October 1999 (Phase I) and 25 January 2000 (Phase II). Selected boring locations either did not need to be moved or were moved only 1 or 2 feet to avoid subsurface utility lines. In addition, USA Underground Services Alert was contacted for cable and utility line checks prior to drilling.

3.1.2 Underground Storage Tank Investigation

The geophysical survey to identify the location of the gasoline UST was performed on 27 October 1999. It was performed between the lube rack and vehicle maintenance building (considered the most likely location of the gasoline UST), to the southeast of the lube rack, and inside the vehicle maintenance building to the northwest (see Figures 3-1 and 3-2). The area covered was approximately 60 feet by 55 feet.

It was thought that the vehicle lube rack and the vehicle maintenance building would cause interference with the geophysical survey, as had happened during the 1996 subsurface soil investigation. The vehicle lube rack contains metal that causes interference, and the vehicle maintenance building walls might also cause interference. Prior to the geophysical survey, CDM Federal dismantled and removed the vehicle lube rack. The geophysical survey proceeded with only minor disturbances near building walls.

3.1.3 Underground Storage Tank Investigation Results

No UST-like anomalies were identified in the subsurface (see Appendix A for the subcontractor report). To the southeast of the lube rack, an excavation backfill area was identified, which is presumably the area where the waste oil UST was excavated and replaced with backfill.

3.2 SOIL INVESTIGATION

For this field investigation, a total of 18 soil borings was drilled, lithologically logged, and sampled to characterize subsurface soil conditions and evaluate the extent of soil contamination at the site. The locations of the soil borings drilled are shown on Figure 3-3, and drilling and sampling information for the soil borings is summarized in Table 3-1.

As originally proposed in the Work Plan (CDM Federal 1999), both DP and HSA methods were used for soil drilling and sampling. The HSA method was to be used for drilling and soil sampling at the locations for permanent groundwater monitoring wells and the DP method was planned for the other soil and groundwater grab sampling locations. However, during the first attempt using the DP method, drive rod refusal was encountered at a depth of 16 feet bgs due to the firm, well-consolidated soil conditions present at the site. Therefore, use of the DP method for soil sampling was abandoned and all DP-series borings were drilled and sampled using the HSA method. The DP and HSA drilling and sampling techniques used for this project are discussed below.

3.2.1 Direct Push Soil Sampling

DP soil sampling was performed at only one boring location during Phase I. As noted above, DP soil probe sampling was abandoned after encountering firm soil conditions in the first boring (DP03) attempted with this method. The DP soil sampling system used at this location involved hydraulically advancing a 1.5-inch outer-diameter (OD) stainless steel probe point and rod system to collect soil samples for logging and chemical analysis. Upon reaching the desired sampling depth (generally 5-foot intervals), the DP rod was removed and replaced with a 2.0-inch OD, 24-inch long, split-core sampler containing four 0.875-inch diameter, 6.0-inch long, stainless steel sample sleeves. The sampler was driven two feet to collect the soil sample and was then removed. The recovered sample sleeves for laboratory analysis were capped and labeled; the remaining soil material was used for organic vapor meter (OVM) field screening.

and logging. Only two soil samples were collected in DP03 using the DP method prior to switching to the HSA drilling method.

3.2.2 Hollow-Stem Auger Drilling and Soil Sampling

All 18 soil borings completed for the investigation were drilled and sampled using the HSA method (see Figure 3-4). The seven borings in which groundwater monitoring wells were installed were drilled using 10-inch OD augers, while 6-inch OD augers were used for all of the DP-series borings. All soil sampling was performed using a 2.0-inch diameter, 18-inch long, California-modified, standard penetration split-spoon sampler. Soil sampling was accomplished following the procedures described in the Field Sampling Plan included in the Work Plan (CDM Federal 1999). Boring logs for the 18 soil borings drilled and sampled are included in Appendix B. The soil borings inside the vehicle maintenance building used a limited access rig (see Figure 3-5) because the ceiling of the building was too low to allow the mast of the main drilling rig to be raised completely.

Soil samples for laboratory analysis were collected in 6-inch long (or 3-inch long) stainless steel sleeves. Upon retrieval of sample sleeves from the sampler, the exposed soil at the end of the sleeves was monitored with an OVM. The OVM used for HSA and the limited DP sampling (described above) was a Thermo Environmental Instrument model 580B with a 10.6-electron-volt (EV) lamp. The bottom two sleeves were kept as samples. Both ends of the 2-inch OD, 3- and 6-inch long stainless steel sample sleeves were then immediately capped with Teflon™ squares and plastic end caps. The extra soil was placed in a labeled, self-sealing plastic bag for lithologic logging.

At each sampling location, four soil samples were collected. These four samples were generally collected at approximately evenly-spaced depths (for example 6, 12, 18, and 24 feet bgs) to obtain vertical profiles of potential contamination. At the location suspected as being the most likely source of contamination (boring DP01), one additional soil sample was collected and analyzed to obtain a more complete vertical profile.

3.2.3 Soil Analyses and Methods

A total of 82 discrete-depth subsurface soil samples were collected from the set of 18 borings completed during the Phase I and Phase II investigations. Of these 82 soil samples, 69 were regular site samples and 13 were field QC duplicate samples. Of the 69 regular site samples, 28 soil samples were designated as background samples, collected from locations distant from the lube rack/former gasoline UST area (see Figure 3-3) and analyzed only for 19 metals to assess background metals concentrations (see Section 4.3). The remaining 45 soil samples were analyzed for potential contaminants of concern, fate and transport parameters, and geotechnical parameters as identified in Table 3-1 and below. Table 3-1 includes a summary of the number and location of soil samples collected and submitted for analyses; details of the analytical tests performed for each sample are shown in Appendix H. Soil sampling results are presented and discussed in Section 4.4.

A total of 45 soil samples (and 5 duplicate field QC samples) were submitted for analysis for fuel and waste contaminants using the following analyses and methods:

- Nineteen metals plus aluminum and iron, using EPA Method 6010 (EPA Method 7470/1 for mercury). All 28 background samples were also analyzed for metals;
- Total Petroleum Hydrocarbons (TPH), using the California Department of Health Services LUFT Method (EPA Method 8015-modified [8015M]) for volatile (gasoline) and extractable (diesel and motor oil);
- Organic lead using the California LUFT method;
- Volatile organic compounds (VOCs), including methyl-tertiary-butyl ether (MTBE), using EPA Method 8260B;
- Semivolatile organic compounds (SVOCs) using EPA Method 8270C; and
- Polychlorinated biphenyls (PCBs) using EPA Method 8082.

In addition, ten selected soil samples were analyzed for leachability assessment using one or more of the following tests:

- TPH: Soluble Precipitation Leachate Procedure (SPLP) extraction using EPA Method 1312, analysis by the California LUFT method, (EPA Method 8015M);
- Metals: Soluble Threshold Limit Concentration (STLC) preparation using California Waste Extraction Test (WET) and analysis EPA Method 6010 and 7470/1;
- VOCs: STLC preparation using California WET and analysis by EPA Method 8260B; and
- SVOCs: STLC preparation using California WET and analysis by EPA Method 8270C.

A total of 16 soil samples were submitted for chemical analysis for the following parameters considered useful for assessing the fate and transport of contaminants in soil:

- Total organic carbon (TOC) using EPA Method 410.1;
- Total phosphorus using EPA Method 365.2;
- Total Kjeldahl nitrogen using EPA Method 351.3, nitrate using EPA Method 353.2, and ammonia using EPA Method 350.1.; and
- Sulfate using EPA Method 300 and sulfide using EPA Method 376.

3.3 SOIL GEOTECHNICAL CHARACTERIZATION

Geotechnical sampling procedures and results are discussed in the subsections below.

3.3.1 Geotechnical Sampling

Ten soil samples were collected for geotechnical analysis from five of the soil borings, as identified in Table 3-1. These samples were collected using a thin-walled Shelby tube sampler (six samples) and standard penetration split-spoon sampler (four samples) and analyzed by Environmental Geotechnology Laboratory of Santa Fe Springs, California. The soil samples were analyzed for grain size distribution, porosity, bulk density, and permeability. Five of the ten samples were collected from the unsaturated zone to assess migration and leaching potential of contaminants within the soil. The remaining five geotechnical samples were collected from the saturated zone to assess the migration and transport of contaminants in groundwater.

3.3.2 Geotechnical Testing Results

The results of geotechnical analyses and tests of soil samples are presented in Table 3-2. Nine of the samples submitted for analysis were classified during field logging as sandy clay (see boring logs, Appendix B). One soil sample was classified as fine-grained sand (13-foot sample, MW06). The grain size distribution analyses listed in Table 3-2 are consistent with the field classification of the soil samples. Triaxial permeability tests of the sandy clay samples indicated hydraulic conductivity values ranging from 4.4×10^{-7} to 9.4×10^{-9} centimeter per second (cm/sec). A permeability of 1.4×10^{-4} cm/sec was measured by the laboratory for the sample of fine-grained sand collected at boring MW06 (13-foot sample). Table 3-2 also lists the moisture content, density, and porosity test results for the soil samples analyzed. Grain size distribution curves and the laboratory reports for the geotechnical soil sampling are included in Appendix C. The soil geotechnical test results are evaluated and discussed as part of the site hydrogeologic characterization (Section 3.3).

3.4 GROUNDWATER INVESTIGATION

The groundwater investigation performed for this project included the installation of groundwater monitoring wells and temporary piezometers, measurement of water levels in wells and piezometers, and collection and analysis of groundwater samples for fuel/waste contaminants, background metals evaluation, and fate and transport parameters. The activities and procedures for monitoring well and piezometer installation, water level measurements, and groundwater sampling and analysis are discussed below.

As noted in the boring logs (Appendix B), groundwater was encountered at depths ranging from 28 to 33 feet bgs in all soil borings, except MW04 (drilling terminated at 19 feet due to refusal). Following well construction, the static water levels within the wells ranged from approximately 21 to 31 feet bgs.

3.4.1 Monitoring Well Installation and Development

A total of seven groundwater monitoring wells were installed during this investigation to complete the site characterization and to serve as permanent locations for future monitoring. Five monitoring wells were installed during Phase I and two monitoring wells were installed during Phase II. The locations of the seven groundwater monitoring wells are shown on Figure 3-3. Table 3-3 summarizes well construction information for each well.

The monitoring wells were drilled and installed using the HSA method following the field investigation program described in the Work Plan (CDM Federal 1999). As described in the Work Plan Addendum (CDM Federal 2000), the following modifications to the original Work Plan were made:

- During Phase I, a background monitoring well, MW04, was planned to be installed on the northwest side of the administration building (see Figure 3-3). However, drilling refusal was encountered at a depth of 19 feet bgs (unweathered bedrock) and it was unlikely that shallow groundwater conditions would be found at this location. Therefore, the monitoring well scheduled for background location MW04 was drilled and installed immediately adjacent to soil boring DP04. The background monitoring well was designated MW04B (Figure 3-3, Table 3-3).
- The Work Plan called for installation of up to three monitoring wells during Phase II and a contingency for two additional monitoring wells during Phase III. However, based on the results of Phase I, it was determined to be more appropriate to collect a broader coverage of groundwater samples utilizing temporary piezometers and wells (during a single mobilization in Phase II) rather than implementing the Phase II and Phase III well installation program described in the Work Plan Addendum Number 1 (CDM Federal 2000). This plan and rationale was approved by DTSC in January 2000. Accordingly, the groundwater investigation was completed during Phase II and involved the installation of two permanent monitoring wells and four temporary piezometers (described below).

Each of the groundwater monitoring wells was constructed using 4-inch OD, Schedule 40 polyvinyl chloride (PVC) well casing, a 15-foot section of factory-slotted well screen, and a 2.5-foot blank casing sump and end cap assembly. A grain size distribution analysis of a

sample of the predominant soil type at the site (sandy and silty clay) was used to confirm the specifications for well screen slot-size and filter-pack sand. Based on the grain size analysis of soil from the saturated zone at MW01, a slot-size of 0.010-inch and #2/16 grade sand was selected for monitoring well construction. Refer to Appendix C for the grain size analysis used (MW01 35-foot bgs sample). The saturated well screen interval was surged during well construction to ensure proper placement of the filter-pack sand. All monitoring wells were completed with flush-set, surface well boxes. Well completion diagrams and complete information on drilling and construction for the Phase I and Phase II groundwater monitoring wells are included in Appendix D.

Following well construction, the monitoring wells were developed using the surge-block and bailer method. For each well, the saturated well screen interval was surged to remove fines from the filter pack and promote groundwater flow into the well. A large capacity bailer was used to remove sediment-laden water from the wells. During Phase I, field parameters (pH, conductivity, temperature, and turbidity) were measured to document stabilized conditions during development. For the moderate recharge wells (wells MW01, MW03, MW04B, and MW05), it was found that field parameters stabilized after approximately three casing-volumes were removed. Wells MW02, MW06, and MW07 were found to be low recharge wells and required multiple purgings to complete well development.

3.4.2 Temporary Piezometer Installation

As described in the Work Plan (CDM Federal 1999), the DP soil probe and sampling system was originally planned to be used for collecting groundwater grab samples from the DP-series soil borings. However, since the DP probe method was not used, groundwater grab sampling was conducted in temporary piezometers that were installed in selected DP-series borings drilled using the HSA method. The temporary piezometers were constructed of 2-inch diameter, Schedule 40 PVC well casing and a 10-foot section of 0.010-inch slotted well screen with end cap, installed directly (without filter-pack) in the DP-series boreholes. Groundwater

grab sampling from temporary piezometers, as described below, was the most practical and efficient method given the volume of samples needed for analysis.

Temporary piezometers for groundwater sampling and water level measurements were installed in a total of seven DP-series borings as listed in Table 3-1. The temporary piezometers were removed after groundwater sampling, and the boreholes were sealed with cement-bentonite grout and/or bentonite pellets.

3.4.3 Water Level Measurements

Water levels were measured in all groundwater monitoring wells and temporary piezometers on several dates during the field investigation to assess groundwater gradient and flow direction. In the monitoring wells and piezometers, water levels were measured individually prior to groundwater sampling and collectively during site-wide monitoring surveys. A standard diameter, Solinst™ (or equivalent) water level meter was used. The water level measurements and groundwater elevations obtained during the Phase I and Phase II field activities are presented in Table 3-4. Discussion of water level monitoring results and groundwater gradient and flow conditions is provided in Section 4.2.

3.4.4 Groundwater Sampling

Two groundwater sampling rounds were conducted for this investigation. Phase I sampling was conducted during November 2-16, 1999 and included groundwater sampling at five monitoring wells and three temporary piezometers. Phase II sampling was conducted January 25 through February 1, 2000 and included groundwater sampling from two new wells and four piezometers installed for Phase II, and the re-sampling of three wells installed during Phase I (CDM Federal 2000).

More groundwater samples were collected during Phase II than originally planned, with the purpose to collect a more complete data set. Grab samples from temporary piezometers were

substituted for some wells because the groundwater flow direction had been inferred using Phase I water level measurements. Phase II grab samples were collected from cross-gradient locations, while Phase II wells were installed in the downgradient direction. Three wells were resampled (at the request of DTSC) to confirm sampling results from Phase I two months earlier. Table 3-5 provides a summary of the groundwater monitoring wells and piezometers that were sampled during Phase I and Phase II investigations.

The groundwater monitoring wells sampled during Phase I and Phase II were initially purged of a minimum three-casing volumes or purged dry (low recharge wells) using a temporary, 2-inch diameter, variable speed electric submersible pump (Grundfos RediFlo2 model). During purging, a water quality meter was used to record temperature, pH, specific conductance, dissolved oxygen, oxygen reduction potential (ORP), and turbidity to assess field parameters. High turbidity values were recorded at wells MW02 and MW03. All of the wells were constructed using the same design and development procedures, so it is unknown as to why these two wells had the high turbidity while the other wells did not. As stated in Section 3.4.1, a grain size distribution analysis was used to confirm the specifications for the well screen slot-size and filter-pack sand. It is possible that the soil conditions at these two wells are different from the soil sample collected to determine the slot-size and filter-pack size. Lithologic logging for well MW03 identified that silty clay was encountered at the screened depth versus sandy or pebbly clay at all the other wells. During development of both MW02 and MW03, the wells were purged dry multiple times. Development was completed with turbidity values still high, but with stable parameters for pH, conductivity, and temperature. Table 3-6 lists the final, stabilized field parameter readings obtained before sampling. Groundwater purging and sampling logs for the monitoring wells sampled during Phase I and Phase II are included in Appendix E.

Groundwater samples were collected from each monitoring well using a disposable Teflon™ bailer and new nylon string. Groundwater samples were collected in 40-milliliter (mL) glass vials, one-liter amber glass and polyethylene bottles, and 125-mL and 500-mL polyethylene

bottles, as appropriate for the laboratory analyses. A peristaltic pump with inert tubing and an in-line 0.45 micron filter was used to prepare filtered samples for dissolved metals analysis. Field QC samples collected during groundwater sampling included duplicate, equipment rinsate, and field/trip blank samples as described in Section 3.8.

Groundwater grab samples from the temporary piezometers were collected using a disposable Teflon™ bailer and new nylon string. Sample containers and preparation followed the procedures used for the conventional well sampling described above. However, well purging and measurement of field parameters was not performed during collection of groundwater grab samples.

3.4.5 Groundwater Analyses and Methods

All groundwater samples collected from the monitoring wells and piezometers were submitted to a Naval Facilities Engineering Service Center-approved laboratory for analysis.

Groundwater samples were analyzed for a variety of organic and inorganic parameters as discussed in the Work Plan (CDM Federal 1999). Specific analyses and methods used for the groundwater samples are summarized below and detailed in Appendix H.

A total of 19 groundwater samples (i.e., 17 regular samples and 2 field QC duplicate samples) were submitted for analysis for fuel and waste contaminants using the following analyses and methods:

- TPHs, using the California Department of Health Services LUFT Method (EPA Method 8015M) for volatile (gasoline) and extractable (diesel and motor oil);
- VOCs, including MTBE, using EPA Method 8260B;
- SVOCs using EPA Method 8270C;
- PCBs using EPA Method 8082;
- Nineteen metals, including both total and dissolved (filtered) analyses, using EPA Method 6010 (7470/1 for mercury). Metals analysis was performed on both filtered and unfiltered groundwater samples. Unfiltered analysis provides

the results of the total metals, while filtered analysis provides the results of dissolved metals. Unfiltered analysis will typically present higher concentrations of metals due to undissolved metals adhering to suspended solids and silts. Turbid groundwater samples can cause very high concentrations due to this adherence factor. Very turbid water can also affect filtered samples in that the filter used for the samples reaches its filtering capacity and solids are able to pass through the filter, biasing the sample results; and

- Organic lead using the California LUFT method.

Groundwater samples were also analyzed for the following general chemistry parameters:

- Total dissolved solids (TDS) using EPA Method 160.1;
- Chloride using EPA Method 300.0;
- Cations (calcium, magnesium, potassium, sodium) using EPA Method 6010;
- Alkalinity using EPA Method 310.1;
- Sulfate, fluoride, bromide, and orthophosphate using EPA Method 300.0 and
- pH using EPA Method 9040.

Selected groundwater samples were submitted for chemical analysis for the following parameters for assessing the fate and transport of contaminants in groundwater:

- Ammonia using EPA Method 350.3;
- Total Kjeldahl nitrogen using EPA Method 351.3;
- Nitrate as N using EPA Method 300;
- Dissolved oxygen using the Robert S. Kerr Environmental Research Laboratory (RSK) Method 175; and
- Carbon dioxide, methane, ethane, and ethene using RSK Method 175.

Data validation reports (that include laboratory sample results) for the Phase I and Phase II sampling rounds are included in Appendix O. The laboratory analytical results for the groundwater sampling are presented and discussed in Section 4.5.

3.5 LAND SURVEYING

A licensed land surveyor, Dulin and Boynton of Signal Hill, California, surveyed the locations and elevations of all 19 soil borings and groundwater sampling locations installed for this project. Surveying was performed on 11 November 1999 and 27 January 2000. Locations were referenced to National Geodetic Survey control points for horizontal and vertical control. The boring/well locations were referenced to the California Lambert System for Zone 5 (California State Plane Coordinate System) to the nearest 0.1-foot. Ground surface and well elevations were surveyed, to the nearest 0.01-foot, relative to mean sea level (MSL), adjusted to National Geodetic Vertical Datum (NAVD) 29. Location surveying data are presented in Appendix F.

3.6 INVESTIGATION-DERIVED WASTE MANAGEMENT

Investigation-derived waste (IDW) generated during this project consisted of the following: soil cuttings generated during drilling activities; wastewater from decontamination activities; wastewater from well development and well purging; soil extruded from sample sleeves following lithologic logging; tubing and filters used with the peristaltic pump for groundwater sampling for dissolved metals; plastic sheeting, paper towels, and duct tape; and personal protective equipment (PPE), such as nitrile gloves.

Water IDW and soil IDW were placed into 55-gallon Department of Transportation (DOT) approved open-top drums. All drums were identified with labels indicating date of collection, type of waste, generator, and the phrase "pending analysis." All drums were stored in the bermed, covered storage area 40 feet southeast of the lube rack. After receipt of laboratory analyses of the contents, 51 drums of IDW from Phase I were classified as nonhazardous and one drum was classified as state-regulated (due to benzene levels) and all were picked up for disposal on 06 January 2000 by Environmental Dynamics, Inc. of Gardena California. All twenty-six drums of IDW from Phase II were classified as nonhazardous and were picked up

for disposal on 23 March 2000 by Environmental Dynamics, Inc. Mr. John Crow of Naval Reserve Forces West signed all manifests for the Navy and Marine Corps as generator.

Plastic sheeting, paper towels, duct tape, PPE, tubing, and filters were placed in new trash bags daily, then disposed as nonhazardous waste.

3.7 SAMPLE LABELING AND MANAGEMENT

All samples were labeled and managed as described in the Field Sampling Plan (FSP) and Quality Assurance Project Plan (QAPP) (CDM Federal 1999).

Sample identification (ID) numbers included five strings of characters. The first 2-character string identified the year the sample was collected and the site abbreviation "RC" for Reserve Center (i.e., "99RC" indicates that the sample was collected in 1999 at the NMCRC-LA Reserve Center site). The second string, four characters long, identified the unique location identification (e.g., MW01 for monitoring well number 1). The third character string identified the sample matrix (S for soil, W for water, WF for filtered water). The fourth character string identified whether the sample was a primary sample ("1"), a duplicate ("3"), an equipment rinse sample ("5"), a field blank ("7"), or a trip blank ("9"). The final sample character set identified the sample depth in feet bgs.

The following is an example of a sample number:

99RC-MW01-S-1-16

99RC	=	1999, Reserve Center site
MW01	=	Location MW01
S	=	Soil sample
1	=	Primary sample
16	=	Depth to top of sampling interval (16 feet bgs)

Samples were labeled with the following information: sample ID, analyses required, sample matrix, preservative, date and time sampled, and the initials of CDM Federal employees who performed the sampling. For groundwater samples, labels were affixed to the containers and taped with clear packing tape immediately before the sample was collected to avoid water damaging the label. For soil samples, labels were affixed after sampling.

Samples were packaged and shipped in accordance with CDM Federal's standard operating procedures (SOPs) presented in the QAPP (CDM Federal 1999). Glass sample containers were placed in self-sealing plastic bubble bags and then into a self-sealing plastic bag. Soil samples were placed directly in self-sealing plastic bags. Sample IDs and analytical requests were recorded on the appropriate chain-of-custody (COC) form, and after all labeling and custody information were verified, the samples were placed in insulated coolers for shipment to the analytical laboratory. Adequate packaging materials were used to minimize the potential for breakage. In addition, adequate ice was used to maintain cooler temperatures at $4 \pm 2^{\circ}\text{C}$ during shipment. The cooler was adequately sealed and a signed custody seal was applied to the opposite sides of the cooler lid for security and accountability.

The samples were transferred to a representative of the subcontract analytical laboratory each evening. The laboratory employee then delivered the samples to the laboratory each evening.

3.8 DECONTAMINATION PROCEDURES

All nondisposable equipment, including soil sampling sleeves, push rods, development bailer, and HSA augers and flights were decontaminated before the start of work and between sampling locations in accordance with CDM Federal SOPs presented in the Work Plan (CDM Federal 1999) and summarized below.

Three 5-gallon buckets, placed on a 4-foot by 6-foot plastic sheet, were used for decontamination. Equipment was scrubbed in the first bucket, which contained Alconox detergent and tap water, then rinsed separately in tap water in the second bucket. Finally,

equipment was sprayed with deionized water and then sprayed with methanol to enhance VOC evaporation. Equipment was allowed to air dry on new plastic sheeting.

The decontamination procedure for the submersible pump and dedicated tubing was to run tap water containing Alconox from a large tub through the pump and tubing for approximately two minutes, followed by running tap water only from a second large tub through the pump and tubing for approximately two minutes, and finally a high-pressure hot water wash of the outside of the equipment.

At the end of the day, all decontamination water was containerized in 55-gallon drums and stored in the bermed and covered area designated for temporary storage of IDW. The buckets were then rinsed with water and emptied in the same manner. Spectrum Exploration decontaminated the drilling rig augers using high pressure hot water wash and sampling equipment (e.g., split spoon samplers) were decontaminated using the bucket method as described above.

3.9 LABORATORY ANALYSIS

Laboratory analyses were based on the types of potential contaminants that were suspected at this site. The list of analyses performed, their method number, and the rationale for performing these tests are listed in Table 3-7. The actual analyses requested and performed for each sample are also listed in Appendix H.

Samples collected for chemical analysis for this project were analyzed by Applied Physics and Chemistry Laboratory (APCL) of Chino, California. APCL is a Naval Facilities and Engineering Service Center (NFESC)-approved laboratory. Validated analytical results are presented in Appendix O.

3.10 QUALITY CONTROL

The following sections describe QA methodologies and procedures including field QC, laboratory QC, and data validation.

3.10.1 Field Quality Control

Field QC samples collected included trip blanks, field blanks, equipment rinse blanks, and field duplicates. All QC samples were collected and handled in accordance with the project-specific FSP and QAPP (CDM Federal 1999) and CDM Federal SOPs (CDM Federal 1999). Field QC sample results are presented in Appendix I of this report.

3.10.1.1 Trip Blanks

Trip blank samples were provided by the analytical laboratory in sealed, 40-ml vials with Teflon™ septa. Each vial was filled with American Society for Testing and Materials (ASTM) deionized water and preserved with 1:1 hydrochloric acid (HCl). Trip blanks were included in each cooler that contained samples for VOCs analysis. Trip blank samples were analyzed to check whether any potential contaminants had been introduced into site samples during sample shipping to the analytical laboratory. Trip blanks were analyzed for VOCs only (NFESC 1996). Five trip blanks were collected during Phase I while six trip blanks were collected during Phase II. Field QC sample results are summarized in Appendix I of this report. Trip blanks were labeled "BT01" for the first trip blank, "BT02" for the second trip blank, "BT03" for the third trip blank and so on.

3.10.1.2 Field Blanks

Two water field blank samples were collected (one during each phase of sampling [November 1999 and January 2000]) to assess whether any contamination existed in the ASTM deionized water used for final equipment decontamination or in the precleaned sample containers supplied by the analytical laboratory. The field blank consisted of ASTM water that was

poured from its original container directly into the respective sample containers for laboratory analysis.

Field QC sample results are summarized in Appendix I of this report.

3.10.1.3 Equipment Rinsate Blanks

Equipment rinsate blanks were collected to assess whether cross-contamination from any sampling equipment may have occurred. An equipment rinsate blank was collected from each type of sampling equipment listed below and was analyzed for the same analytes as samples collected at the site during the same sampling event. The following equipment rinsate samples were collected:

- Groundwater sampling: from the disposable Teflon bailer for Phase I and from the 2-inch submersible pump for Phase II;
- Groundwater sampling: from the dedicated tubing for purging monitoring wells (collected only during Phase I) and analyzed for SVOCs to identify if the tubing was a potential source of SVOCs; and
- Soil sampling: from the split spoon sampler containing stainless steel sleeves (two samples, one during each phase).

Before collecting the rinsate blanks, the sampling equipment was decontaminated according to procedures described in Section 3.8. Rinsate blanks were collected by directly pouring ASTM decontamination water over and through the sampling equipment and into each respective sample container. Field QC sample results are summarized in Appendix I of this report.

3.10.1.4 Field Duplicates

Field duplicate samples were collected at a frequency of one duplicate per 10 samples for each analytical test per medium (e.g., for every 10 soil samples analyzed for VOCs, one duplicate soil sample was collected and analyzed for VOCs). The number of duplicates collected was rounded up to enhance quality control. Duplicate samples were collected for both soil and

groundwater samples. Duplicate samples were collected at the same location as the original sample but were assigned a different sample identification number and shipped to the analytical laboratory “blind.” Duplicate samples were collected as follows:

- Groundwater: immediately after the original sample, from the same location;
- Soil: 1 foot deeper than the original sample.

3.10.2 Laboratory Quality Control

Analytical results for laboratory quality control samples including method blanks, matrix spike/matrix spike duplicate (MS/MSDs), laboratory control sample (LCS)/LCS duplicates (LCSDs), and surrogates were checked during the data validation process (Section 3.10.3). Laboratory instruments were calibrated according to the analytical method requirements and the calibration records were also validated as described in Section 3.10.3.

Additional sample volume for laboratory MS/MSD analyses (used by the laboratory once per batch of 20 or less samples to assess whether the sample matrix had affected extractability of analytes and results) was collected for laboratory QC analyses. MS/MSD volumes typically included two to three times the original sample and were assigned the same sample identification number. Each MS/MSD sample was marked “MS/MSD” on the COC form to inform the lab that MS/MSD volume was collected.

Soil sample results were reported in dry weight to eliminate effects of soil moisture on sample results.

3.10.3 Data Validation

Data validation was performed by Laboratory Data Consultants (LDC) of Carlsbad, California. Data validation was performed according to the following guidelines:

- *U.S. EPA Contract Laboratory Program National Functional Guidelines for Evaluating Organic Analyses* (EPA 1994a and EPA 1996b);
- *U.S. EPA Contract Laboratory Program National Functional Guidelines for Evaluating Inorganic Analyses* (EPA 1994b); and
- Interim Guidance Document *Navy Installation Restoration Laboratory Quality Assurance Guide* (NFESC 1996).

Raw data were validated for ten percent of the sample analyses per matrix; raw data validation followed EPA Level IV QC (formerly designated as Navy “Level D”). The remaining 90 percent of the data were validated for other QC criteria not including raw data, following EPA Level III QC (formerly designated as Navy “Level C”). This data validation strategy followed SWDIV Policy Memorandum No. 13 for non-National Priority List (NPL) sites (SWDIV 1996).

Of the ten percent selected for comprehensive raw data validation, approximately half were selected based on relatively high analyte concentrations or unexpected results, while the other half were selected randomly. The samples selected for raw data (i.e., Level IV) validation are identified in Appendix O.

The following qualifiers or a combination of these qualifiers were assigned to sample results as necessary:

J	Estimated concentration
U	Not detected (i.e., undetected)
N	Analyte identity uncertain
R	Rejected data (i.e., unusable)

Data validation reports are compiled in Appendix O and a summary of data validation results is presented at the beginning of Appendix O. Data validation results and the usability of data are summarized in Section 5.3 and 5.4.

3.11 DATA MANAGEMENT

Data were received from the analytical laboratory on hard copy and on computer diskettes as an electronic data deliverable (EDD) in a modified Navy Environmental Data Transfer Standard (NEDTS). Data from the EDD were verified manually against the hard copy laboratory reports for accuracy, then corrected as necessary. Data validation results were then entered into the electronic files. Finally, data will be submitted with the final report to SWDIV in NEDTS format.

Data were also managed and queried in an Excel spreadsheet format, as part of assessing the nature and extent of contamination (Section 4), contaminant fate and transport (Section 6), and HHRA (Section 7).

Table 3-1
Drilling and Soil Sampling Summary NMCRC-LA, 1999-2000

Boring No.	Date Drilled	Total Depth of Soil Boring (feet bgs)	Number of Soil Samples Submitted for Analyses				Well Installation/Remarks	
			Fuel & Waste Contaminants	Fate & Transport(h)	Background	Geotechnical		
Phase I Soil Borings								
MW01	1-Nov-99	38	4	2		2	33	monitoring well MW01
MW02	9-Nov-99	43	4	2		2	33	monitoring well MW02
MW03	4-Nov-99	43			4		34	monitoring well MW03
MW04	8-Nov-99	19(a)			4		NE	boring terminated at 19 feet (refusal)
MW04B	8-Nov-99	41						monitoring well MW4B (substitute for MW04)
MW05	5-Nov-99	36		1	4	2	26	monitoring well MW05
DP01	3-Nov-99	38	5	5			30	temporary piezometer for GG01
DP02	2-Nov-99	35	4	2			30	temporary piezometer for GG02
DP03	2-Nov-99	38	4				30	temporary piezometer for GG03
DP04	3-Nov-99	35			4		30	
DP05	3-Nov-99	35			4		33	
DP06	4-Nov-99	30			4		30	
DP07	2-Nov-99	33			4		32	
Phase II Soil Borings								
MW06	25-Jan-00	38	4	2		2		monitoring well MW06
MW07	24-Jan-00	37	4	1		2	26	monitoring well MW07
DP08	25-Jan-00	38	4	1			30	temporary piezometer for GG08
DP09	24-Jan-00	38	4	1			30	temporary piezometer for GG09
DP10	26-Jan-00	39	4	1			30	temporary piezometer for GG10
DP11	26-Jan-00	39	4	1			30	temporary piezometer for GG11
Total Samples			45	19	28	10		

Notes:

Soil boring depths in feet below ground surface (bgs)

GG = groundwater grab sample

NMCRC-LA = Naval and Marine Corps Reserve Center-Los Angeles

(a) Refusal encountered at 19 feet bgs.

(b) Selected parameters in selected samples (see Appendix H for details)

Table 3-2
Results of Geotechnical Soil Testing NMCRC-LA, 1999-2000

Boring No.	Soil Classification	Sample Depth feet bgs	Grain Size Distribution			Total Porosity	Moisture Content %	Dry Density PCF	Permeability Tests	
			% fines	% sand	% gravel				Hydraulic Conductivity cm/sec	Effective Confining Pressure PSI
Vadose Zone Samples										
MW01	sandy clay	15	63	35	2	0.38	17.4	102.8	3.3×10^{-8}	8.9
MW02	sandy clay	10	54	46	0	0.31	12.8	116.2	9.4×10^{-9}	6.1
MW05	sandy clay	17	60	40	0	0.34	17.9	110.6	1.5×10^{-7}	10.3
MW06	sand	13	11	89	0	0.42	8.6	97.4	1.4×10^{-4}	6.4
MW07	sandy clay	15	61	34	5	0.37	18.7	106.3	1.2×10^{-6}	8.8
Saturated Zone Samples										
MW01	sandy clay	35	55	42	3	0.38	22.2	103.1	4.4×10^{-7}	20.4
MW02	sandy clay	36	64	35	1	0.40	24.9	100.4	1.6×10^{-7}	20.9
MW05	sandy clay	32	64	34	2	0.39	22.1	102.4	6.0×10^{-9}	18.5
MW06	sandy clay	29	65	34	1	0.39	21.7	103.4	1.8×10^{-7}	16.9
MW07	sandy clay	30	57	38	5	0.39	22.1	103.3	1.6×10^{-7}	17.5

Note:

Test methods: Grain Size Analysis (ASTM D-422), Moisture Content & Density (D-2937), Hydraulic Conductivity (D-5084)

Bgs = below ground surface
cm/sec = centimeters per second
NMCRC-LA = Naval and Marine Corps Reserve Center-Los Angeles
PCF = pounds per cubic foot
PSI = pounds per square inch

Table 3-3
Groundwater Monitoring Well Construction Summary NMCRC-LA, 1999-2000

Well No.	Date Constructed	Well Elevations		Well Construction			Well Location
		Ground Surface (ft above MSL)	Top of Well Casing (ft above MSL)	Well Depth (ft bgs)	Screen Interval Depth (ft bgs)	Depth to Water (ft bgs)	
Phase I Wells							
MW01	4-Nov-99	397.93	397.60	40.0	22.5-37.5	27.23	Lube Rack area (former UST)
MW02	9-Nov-99	399.48	399.20	41.0	23.5-38.5	28.65	inside Vehicle Maintenance Bldg.
MW03	4-Nov-99	401.48	400.71	42.5	25.0-40.0	30.20	background well
MW4B	8-Nov-99	402.57	402.28	40.5	23.0-38.0	31.29	background well
MW05	5-Nov-99	391.87	391.52	34.5	17.0-32.0	21.98	downgradient
Phase II Wells							
MW06	25-Jan-00	389.84	389.52	36.0	18.5-33.5	22.13	downgradient (at property line)
MW07	24-Jan-00	393.44	393.10	36.5	19.0-34.0	23.00	downgradient of Lube Rack area

Notes:

Well elevations in feet (ft) above mean sea level (MSL), based on well surveys using National Geodetic Vertical Datum 29.

Wells constructed with 4-inch diameter Schedule 40 polyvinyl chloride (PVC) well casing and screen (0.010" slot).

Water levels measured January 27, 2000.

Well construction depths in feet below ground surface (bgs).

Well datums are top of well casing (TOC) marked measure points.

bgs = below ground surface

ft = feet

MSL = Mean Sea Level

NMCRC-LA = Naval and Marine Corps Reserve Center-Los Angeles

UST = Underground Storage Tank

Table 3-4
Water Level Measurements and Groundwater Elevations NMCRC-LA 1999-2000

Well No.	Screen Interval Depth (ft bgs)	Top of Casing Elevation (ft above MSL)	Measurement Date	Depth to Water (ft TOC)	Groundwater Elevation (ft below MSL)	Change from Prior Measurement (+/- feet)
MW-01	22.5-37.5	397.60	08-Nov-99	26.04	371.56	
		397.60	16-Nov-99	26.14	371.46	-0.10
		397.60	24-Jan-00	26.88	370.72	-0.74
		397.60	27-Jan-00	26.90	370.70	-0.02
MW-02	23.5-38.5	399.20	11-Nov-99	26.85	372.35	
		399.20	16-Nov-99	27.61	371.59	-0.76
		399.20	24-Jan-00	28.31	370.89	-0.70
		399.20	27-Jan-00	28.37	370.83	-0.06
MW-03	25.0-40.0	400.71	08-Nov-99	28.30	372.41	
		400.71	15-Nov-99	28.65	372.06	-0.35
		400.71	24-Jan-00	29.57	371.14	-0.92
		400.71	27-Jan-00	29.43	371.28	0.14
MW-4B	23.0-38.0	402.28	09-Nov-99	30.06	372.22	
		402.28	16-Nov-99	30.18	372.10	-0.12
		402.28	24-Jan-00	31.00	371.28	-0.82
		402.28	27-Jan-00	31.00	371.28	0.00
MW-05	17.0-32.0	391.52	08-Nov-99	20.98	370.54	
		391.52	15-Nov-99	21.05	370.47	-0.07
		391.52	24-Jan-00	21.69	369.83	-0.64
		391.52	27-Jan-00	21.63	369.89	0.06
MW-06	18.5-33.5	389.52	27-Jan-00	21.83	367.69	
		389.52	31-Jan-00	22.00	367.52	-0.17
MW-07	19.0-34.0	393.10	27-Jan-00	22.68	370.42	
		393.10	31-Jan-00	22.69	370.41	-0.01
DP-08	28.0-38.0	398.04	27-Jan-00	27.42	370.62	
DP-09	28.0-38.0	397.08	27-Jan-00	26.48	370.60	
DP-10	29.0-39.0	400.53	27-Jan-00	29.64	370.89	
DP-11	29.0-39.0	400.59	27-Jan-00	29.77	370.82	

Notes:

1. Well elevations in feet (ft) above mean sea level (MSL) based on National Geodetic Vertical Datum 29.
2. Well screen depths in feet below ground surface (bgs)
3. Well datums are top of well casing (TOC) marked measure points.
4. Temporary piezometers DP-08 through DP-11 were installed for groundwater grab sampling and water level measurements

The temporary piezometers were removed and the boreholes grouted on 1/27/00

Table 3-5
Groundwater Sampling Program, Los Angeles NMCRC-LA, 1999-2000

Sample ID	Sample Type	November 1999	January 2000	Sample Location
MW01	Well	X	X	Source area
MW02	Well	X	X	Inside vehicle maintenance building
MW03	Well	X		Background
MW04B	Well	X		Background
MW05	Well	X	X	Downgradient
MW06	Well		X	Downgradient
MW07	Well		X	Downgradient
GG01	Grab	X		DP01, near lube rack
GG02	Grab	X		DP02, near lube rack
GG03	Grab	X		DP03, near lube rack
GG08	Grab		X	DP08, cross-gradient
GG09	Grab		X	DP09, cross-gradient
GG10	Grab		X	DP10, inside maintenance building
GG11	Grab		X	DP11, inside maintenance building

Notes:

NMCRC-LA = Naval and Marine Corps Reserve Center-Los Angeles

Table 3-6
Field Parameters Measured During Groundwater Sampling NMCRC-LA, 1999-2000

Well No.	Sample Date	Groundwater Field Parameters						
		Temperature °C	PH units	Conductivity ms/cm	Dissolved Oxygen mg/L	Redox Potential millivolts	Turbidity NTU	Iron II mg/L
MW01	16-Nov-99	23.12	6.58	3.34	5.74	78.0	3.2	negative
	31-Jan-00	22.40	6.89	2.50	3.89	443.0	1.4	negative
MW02	16-Nov-99	24.21	6.65	2.97	5.12	114.3	117.0	negative
	1-Feb-00	22.00	7.05	2.30	4.47	447.0	555.0	negative
MW03	16-Nov-99	23.72	7.25	1.83	1.82	104.9	945.0	negative (a)
MW4B	16-Nov-99	23.79	6.79	1.56	4.15	152.3	51.6	negative (a)
MW05	15-Nov-99	23.55	6.25	4.51	2.94	499.3	3.9	negative (a)
	31-Jan-00	21.40	6.76	3.90	4.62	454.0	2.5	negative
MW06	1-Feb-00	21.40	7.36	3.90	5.90	429.0	34.2	negative
MW07	1-Feb-00	22.40	6.87	4.20	6.13	446.0	20.6	negative

Notes:

(a) Field tests were not performed immediately after sample collection. Results may be biased low.
Table lists the final (stabilized) field parameter readings during well purging for groundwater sampling.
Iron II screening was performed using colorimetric test kit.

°C = Degrees Centigrade
ms/cm = millisiemens per centimeter
mg/L = milligrams per liter
NTU = nephelometric turbidity units
NMCRC-LA = Naval and Marine Corps Reserve Center-Los Angeles

Table 3-7
Laboratory Analysis Program, NMCRC-LA

Laboratory Analysis	Method Number	Reason For Analysis
Chemical Analyses		
Total petroleum hydrocarbons (TPH)	California Dept. of Health Services LUFT, EPA Method 8015 Modified	Gasoline from gasoline UST
Volatile organic compounds (VOCs)	EPA 8260B	Volatiles from gasoline and leaking drums
Methyl tertiary butyl ether (MTBE)	EPA 8260B	Gasoline additive since 1980 (likely not present because of time frame, but must analyze for because of recent regulatory concerns)
Semivolatile organic compounds (SVOCs)	EPA 8270C	Polynuclear aromatic hydrocarbons in waste oil
Polychlorinated Biphenyls (PCBs)	EPA 8082	Possibility of PCBs in waste oil or drums
Metals	EPA 6010 (EPA 7470/1 for mercury)	Leaking hazardous waste drums, waste oil contaminants
Organic Lead	California LUFT	Tetraethyl lead as possible gasoline additive
pH	EPA 9040/9045	Acids or bases in leaking drums (if any)
Anions	EPA 300	Natural attenuation assessment, groundwater geochemistry
Soil moisture content	ASTM D2216	Natural attenuation assessment, report soil data on dry weight basis
Total heterotrophic plate count	SM 9215	Natural attenuation assessment
Total organic carbon (TOC)	EPA 410.1	Natural attenuation assessment, fate and transport of contaminants
Total phosphorus	EPA 365.2	Bioremediation potential assessment
Total Kjeldahl nitrogen	EPA 351.2	Bioremediation potential assessment
Ammonia (as nitrogen)	EPA 350.1	Bioremediation potential assessment
Bromide	EPA 300	Natural attenuation assessment
Chloride	EPA 300	Natural attenuation , groundwater geochemistry
Nitrate	EPA 353.2	Natural attenuation assessment
Sulfate	EPA 300	Natural attenuation assessment
Fluoride	EPA 300	Natural attenuation assessment
Reactive Sulfide	EPA 376.2	Natural attenuation assessment
Total dissolved solids	EPA 160.1	Groundwater geochemistry
Alkalinity	EPA 310.1	Groundwater geochemistry
Dissolved gases, including dissolved oxygen, methane, and carbon dioxide	RSK SOP 175	Indicators of biodegradation
TPH: Soluble Precipitation Leachate Procedure (SPLP)	EPA 1312/California Dept. of Health Services LUFT, EPA Method 8015 Modified	Assess leachability of gasoline in rainwater percolation
Metals: Soluble Threshold Limit Concentration (STLC)	None	Fate and transport of contaminants, IDW characterization
SVOCs -STLC	California Assessment Manual	Fate and transport of contaminants, IDW characterization
VOCs: STLC	California Assessment Manual	Fate and transport of contaminants, IDW characterization

Table 3-7 (continued)
Laboratory Analysis Program, NMCRC-LA

Laboratory Analysis	Method Number	Reason For Analysis
Geotechnical Analyses		
Bulk density	ASTM D2937	Fate and transport of contaminants
Constant Head Permeability	ASTM D2434-68	Fate and transport of contaminants
Total porosity	ASTM D854	Fate and transport of contaminants
Gram/particle size analysis-sieve and fine hydrometer	ASTM D422	Fate and transport of contaminants

Notes:

ASTM	=	American Society for Testing and Materials	SOP	=	Standard Operating Procedure
EPA	=	U.S. Environmental Protection Agency	SPLP	=	Soluble Precipitation Leachate Procedure
IDW	=	Investigation-Derived Waste	STLC	=	Soluble Threshold Limit Concentration
LUFT	=	Leaking Underground Fuel Tank	SVOCs	=	Semivolatile Organic Compounds
MTBE	=	Methyl tertiary butyl ether	TPH	=	Total Petroleum Hydrocarbons
PCB	=	Polychlorinated Biphenyl	TOC	=	Total Organic Carbon
RSK	=	Robert S. Kerr Environmental Research Laboratory	UST	=	Underground Storage Tank
SM	=	Standard Methods	VOCs	=	Volatile Organic Compounds

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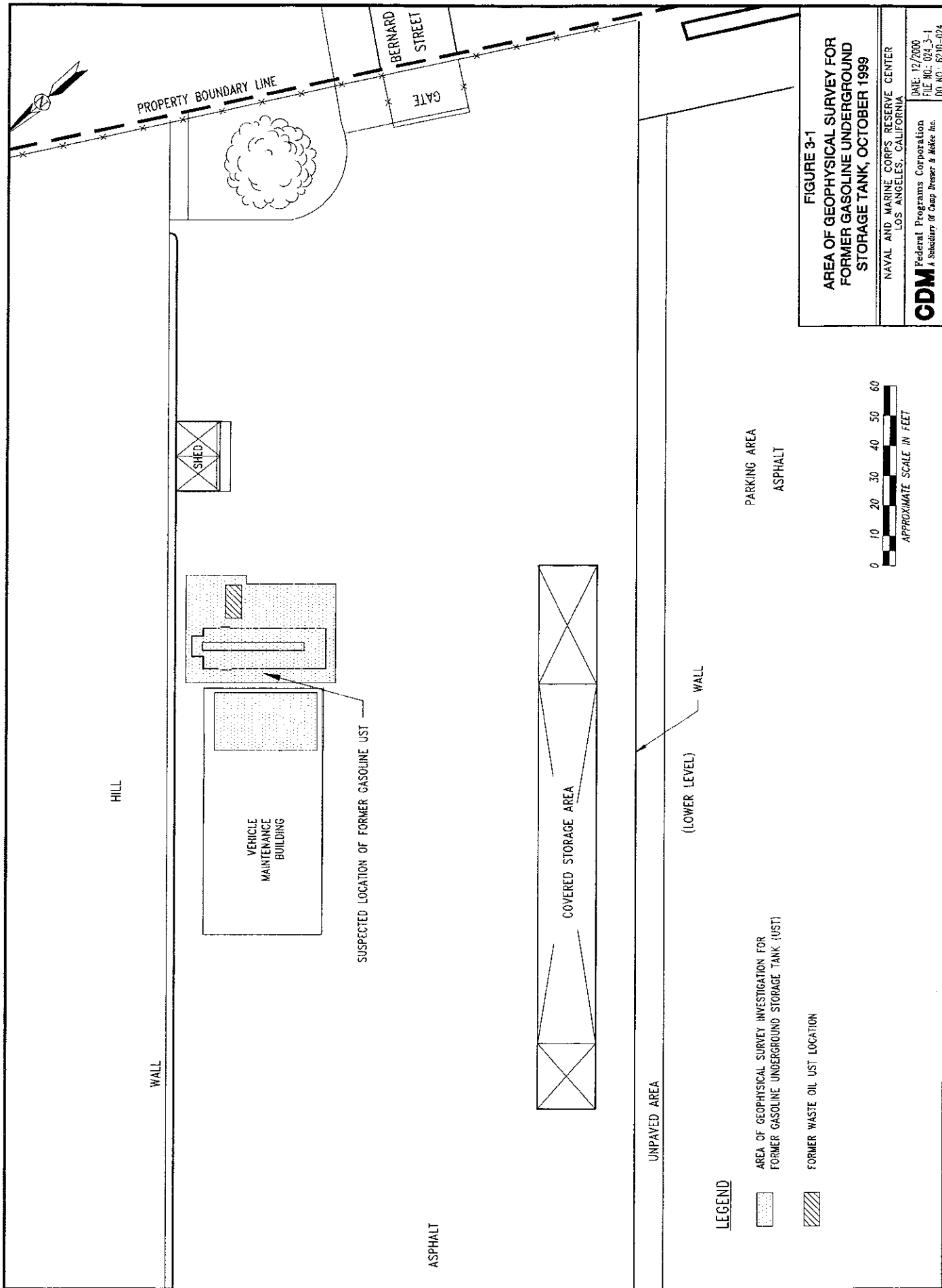
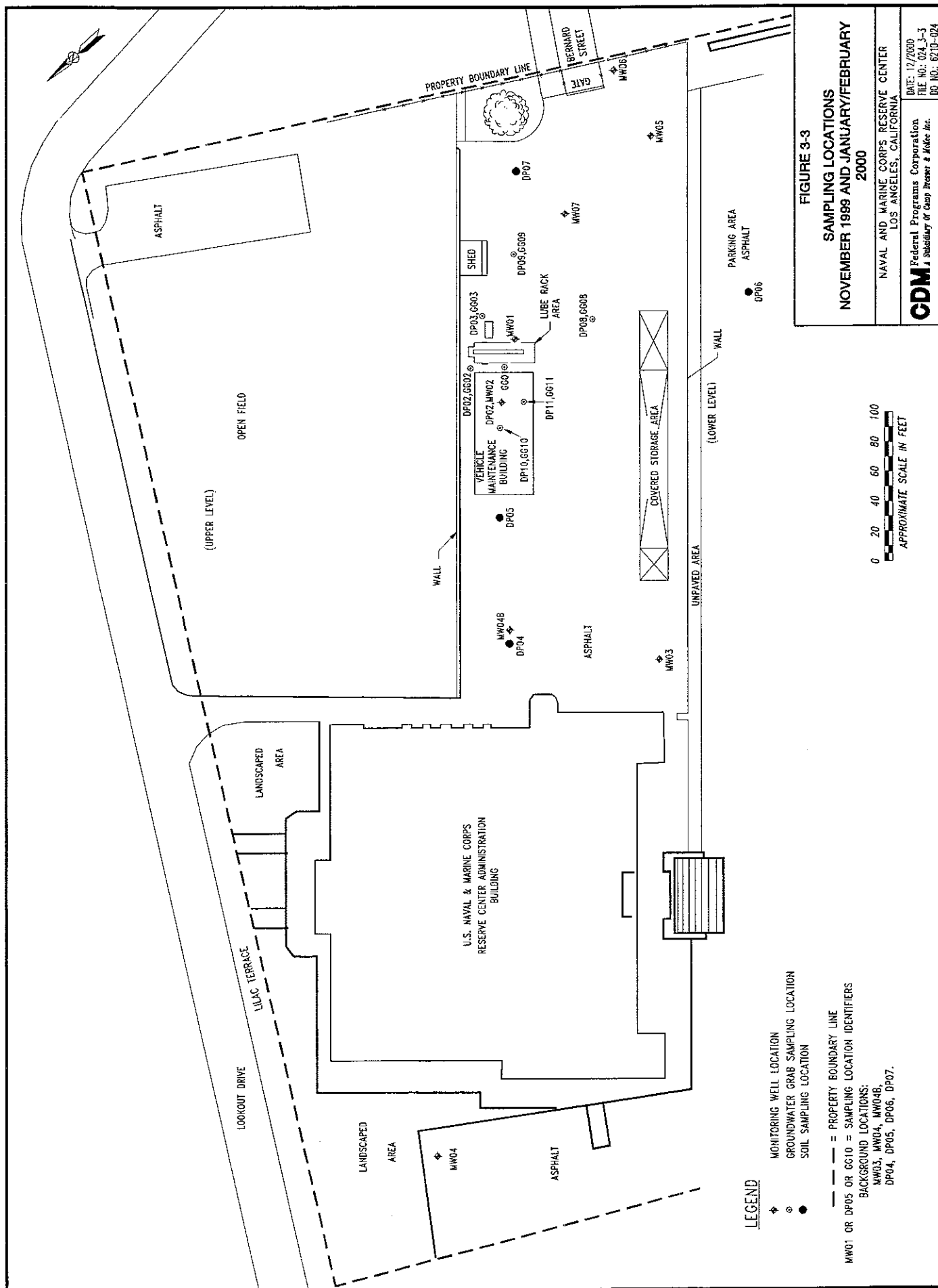




Figure 3-2 Geophysical survey at lube rack and former UST area

Facing northeast
10/27/99



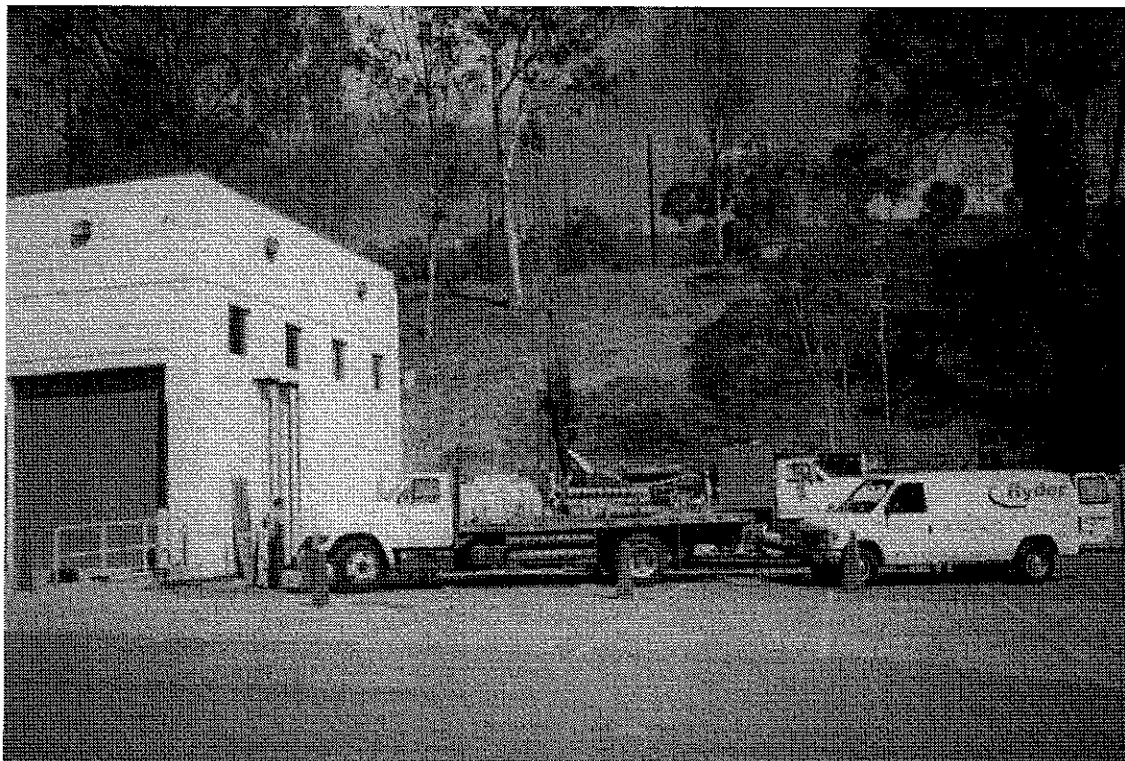


Figure 3-4 Drilling activities (location MW01)

Facing northeast
11/01/99

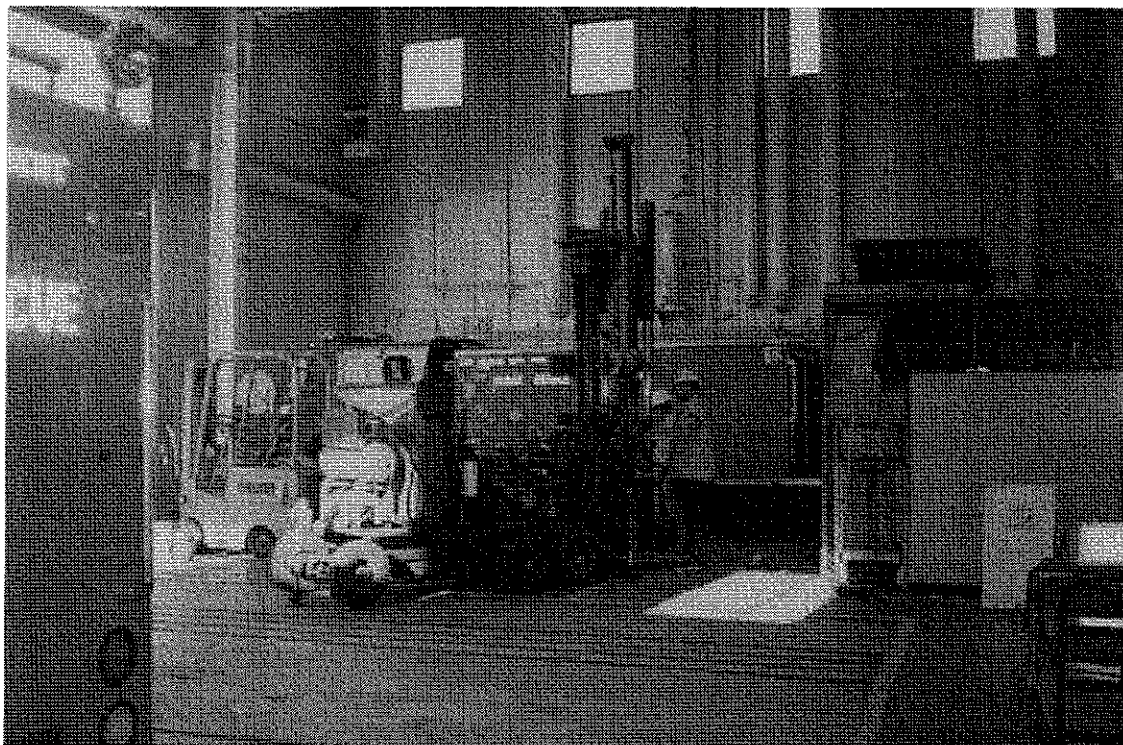


Figure 3-5 Drilling inside Vehicle Maintenance Building (location DP10)

Facing west
01/26/00

4.0 SOIL AND GROUNDWATER INVESTIGATION FINDINGS

This section presents the results and evaluation of the soil and groundwater investigation (Phase I and II) completed at the NMCRC-LA site. The site characterization data collected include lithologic logging of soil borings, geotechnical testing and chemical analysis of subsurface soil samples, water level measurements in groundwater monitoring wells and piezometers, and chemical analysis of groundwater samples. The site data are used to define and characterize the site hydrogeologic setting (Section 4.1), groundwater gradient and flow conditions (Section 4.2), background metals levels (Section 4.3), and the nature and extent of soil and groundwater contamination (Sections 4.4 and 4.5, respectively).

4.1 SITE HYDROGEOLOGY

The NMCRC-LA site is located in an upland topographic setting (Elysian Hills) north of downtown Los Angeles and west of the Los Angeles River. The site is underlain by a thin layer of Quaternary alluvium, which in turn, is underlain by Miocene-age sandstone and shale of the Topanga and Puente formations (BNI 1995). Lithologic logging of the 18 soil borings completed for this SI indicate that subsurface soils underlying the site consist primarily of generally homogeneous, silty to sandy clay. The clay soils occasionally contain bedding structures, sand and pebble layers, and broken shell fragments (possibly marine fossils), confirming that the soils formed from the weathering and degradation of the underlying bedrock sedimentary formations. The depth of residual soil and bedrock weathering in the area of investigation appears to vary from approximately 20 feet (boring MW04) to over 40 feet bgs (boring MW02). The soil types encountered during this investigation are consistent with the geologic conditions reported from the prior soil investigation and UST removal excavation (PWC 1996 Amwest 1995).

Figure 4-1 shows locations of the soil borings, groundwater monitoring wells, and temporary piezometers installed during the Phase I and II field investigations. Also shown on Figure 4-1 are the locations of subsurface cross sections that are discussed in this section. Cross section

A-A' (Figure 4-2) extends from the vehicle maintenance building to the southern boundary of the property and illustrates the depths and well screen intervals of the groundwater monitoring wells/piezometers and the hydrogeologic conditions at the site. Appendix B provides more detailed information on soil conditions underlying the site. The results of the soil analyses are presented and discussed in Section 4.4.

Groundwater entry into the boreholes was first encountered at depths ranging from 27 to 35 feet bgs (see boring logs in Appendix B). Following well installation, the water levels in the monitoring wells/piezometers rose and equilibrated to depths ranging from 22 to 28 feet bgs as shown by the potentiometric surface line in the hydrogeologic cross section (Figure 4-2). The rise in static water levels reflects the hydraulic pressure (head) within the shallow groundwater zone and defines the capillary fringe interval between the unsaturated and saturated zones.

The shallow groundwater zone at the site appears to be developed solely within the residual soils overlying unweathered bedrock formation and therefore reflects essentially a perched water condition. However, since borings were not advanced deeper than 43 feet, hydraulic conditions within the underlying bedrock were not investigated and are not known. According to information cited in the EBS (BNI 1995), no wells are known to produce fresh water from the Topanga or Puente formations in this portion of the Los Angeles Coastal Plain. Presumably, shallow groundwater underlying the NMCRC-LA property accumulates within the residual soil zone and flows laterally (downslope) towards the alluvial basin south of the site, consistent with the regional groundwater flow direction in nearby areas of the Los Angeles Coastal Plain (BNI 1995).

4.2 GROUNDWATER GRADIENT AND FLOW CONDITIONS

The depth to water and corresponding groundwater elevations measured in the site monitoring wells and piezometers were previously summarized in Table 3-4. During the 27 January 2000 water level survey, groundwater elevations ranged from 371.28 feet above MSL (wells MW03 and MW4B) to 367.69 feet MSL (well MW06). A comparison of water levels measured in

five Phase I wells during November 1999 and January 2000 indicate that water levels declined an average of 0.77 feet over this period. The water level decline probably reflects the lack of measurable rainfall (infiltration) in this portion of the Los Angeles area during this time period.

A groundwater elevation map prepared for water level survey data for January 2000 is presented on Figure 4-3. The calculated groundwater flow direction was consistent for both the November 1999 and January 2000 measurements, indicating that groundwater underlying the site flows to the south-southeast. Based on the January 2000 water level data, the horizontal hydraulic gradient is calculated to be approximately 0.003 feet/foot in the upgradient area and steepens to approximately 0.028 feet/foot in the downgradient area between wells MW07 and MW06 (Figure 4-3).

The assessment of groundwater flow rate or seepage velocity at the site is based on hydraulic measurements (groundwater elevation and gradient) and the physical properties of the saturated materials. It should be noted that the hydraulic conductivity estimates for the saturated materials are based on laboratory porosity and permeability tests rather than *in-situ* hydraulic test methods such as pumping tests or slug tests.

Groundwater flow rates are estimated perpendicular to flow based on the potentiometric surface gradient map (Figure 4-3) and the hydraulic conductivity estimates from geotechnical testing results of soil samples (Table 3-3). The predominant soil type underlying the site is a distinctly low permeability material ranging from sandy clay and pebbly/sandy clay. However, the lithologic logging and geotechnical test data confirm that thin sand layers or lenses occur within the unsaturated and saturated zone, presumably interbedded with the fine-grained soils. Accordingly, it is expected that groundwater flow occurs primarily within and along bedding contacts of the higher permeability sandy intervals. The groundwater flow velocity estimates and assumptions for the range of soil types are summarized in Table 4-1 below. A permeability of 1.27 ft/day was assumed, along with a gradient of 0.003 and an effective

porosity of 0.1 to estimate the groundwater velocity in these interbeds at about 16 feet per year.

Based on the above estimates, the net horizontal groundwater flow velocity in the shallow saturated zone is expected to range from approximately 0.3 feet/day (110 feet/yr) in low gradient areas of the site to approximately 2.5 feet/day (910 feet/yr) in the steeper gradient area (wells MW07 and MW06). However, extrapolating these estimates of groundwater flow to areas downgradient of the NMCRC-LA site should be used with caution because information on the shallow groundwater gradient and hydraulic properties of the soils in areas away from the site are not known.

4.3 BACKGROUND METALS ASSESSMENT

Because metals occur naturally in soil and groundwater, it is necessary to differentiate between naturally occurring (background) concentrations and contamination-related concentrations of metals. Appendix J presents details of the background metals assessment procedures and results, while this section summarizes those procedures and findings.

4.3.1 Procedures

The data set used for background metals assessment was selected as described in Appendix J. Validated data from 1999-2000 for 19 metals were used. Eighty-two soil samples and sixteen filtered groundwater samples were used. Samples were categorized into three groups depending on where they were collected: background, source area, and non-source downgradient.

Data were viewed graphically and analyzed statistically. Graphical techniques allowed a qualitative assessment of what results appeared to be high and whether the three groups of spatially-categorized samples appeared to generally be different from each other. The non-parametric Kruskal-Wallis test was used to test for statistical differences in these three groups.

4.3.2 Findings

Table 4-2 summarizes background metals assessment results, while details are provided in Appendix J.

Most metals results appear to be representative of background conditions. No metals results were extremely high (e.g., an order of magnitude above the others).

Soil

For soil, five metals appeared to differ between the three spatial groups and were highest in the source area. These five metals were chromium, cobalt, molybdenum, nickel, and vanadium. It should be noted that aluminum and iron, both analyzed only because they were considered background metals that would be useful in geochemical correlation analysis, had statistically significant differences between the groups and were highest in the source area. It is possible that soil in the source area is naturally enriched in metals, which could falsely cause an interpretation that other metals detected at higher concentrations in the source area are caused by contamination. However, to be conservative, each of these five metals were considered as possibly above background levels and were used in the HHRA (Section 7).

Groundwater

For groundwater, fewer samples were collected, making statistical significance more difficult to attain. Therefore, more emphasis was placed on conservatism and on graphical data analysis techniques. Results indicate that five metals may be above background levels in the source area compared to the background and downgradient areas: barium, cobalt, lead, nickel, and zinc. Two other metals, antimony and molybdenum, were detected at a downgradient location above their respective screening criteria (MCL and PRG, respectively), so these were also included in the HHRA (Section 7).

4.4 RESULTS OF SOIL ANALYSES

The analytical results for soil samples are summarized in the subsections below for the following analytical categories: TPH, VOCs, SVOCs, PCBs, metals, fate and transport parameters, and soil leachability parameters. The nature and extent of contamination are then summarized in Section 4.4.8.

Table 4-3 summarizes the number of samples analyzed for each analytical test, the analytes detected, the number of detections, the maximum concentration, the screening criteria, and the number of sample results above the screening criteria. Figure 4-4 identifies the soil sampling results for TPH that exceeded screening criteria.

4.4.1 Total Petroleum Hydrocarbons

Table 4-4 summarizes TPH results for each soil sample. Figure 4-5 identifies the soil sampling results for TPH for selected borings along the A-A' cross section.

TPH was detected at the highest concentrations adjacent to the vehicle lube rack. The only concentrations that exceeded screening criteria were located at sampling locations DP01 and MW01 adjacent to the lube rack (Figure 4-4). TPH in the gasoline range (TPH-g) was detected most frequently and at the highest concentrations, with detections of TPH in the diesel range (TPH-d) less common and generally at lower concentrations. TPH in the motor oil range was detected much less often and at even lower concentrations. As identified in Section 5.3 and discussed in Appendix O, TPH reported at low concentrations should be viewed with caution because it may have been an artifact, not a true detection.

Sampling location MW01, adjacent to the southeastern edge of the lube rack, had the highest reported TPH-g concentration, 519 mg/kg, at a depth of 10 feet bgs. The sample collected at 5 feet bgs had a lower TPH-g concentration at 263 mg/kg, while the two deeper samples did not have TPH-g detected (Figure 4-5).

Soil boring location DP01, located on the northwestern edge of the lube rack, also had elevated concentrations of TPH-g with the highest concentration, 101 mg/kg, located 15 feet bgs. In the 1996 sampling effort (PWC, 1996), the highest THP-g concentration reported was 3,760 mg/kg at a location approximately 10 feet northeast of DP01 at a depth of 19 feet bgs.

A number of petroleum hydrocarbon analytes representative of gasoline and diesel fuel and/or chemical breakdown products were identified in the lube rack area. These are VOCs and are discussed further in Section 4.4.2.

Figure 4-4 shows that only soil samples from borings DP01 and MW01 had TPH concentrations that exceeded screening criteria. TPH-g (101 mg/kg to 235 mg/kg at DP01 and 263 mg/kg to 519 J mg/kg at MW01) and TPH-d (110J mg/kg to 180 mg/kg at DP01 and 120 mg/kg at MW01) met or exceeded screening criteria (100 mg/kg) at these locations. DP01 had exceedances at depths of 15 and 20 feet bgs, while MW01 had exceedances at depths of 5 and 10 feet bgs. Figure 4-5 also shows the same pattern: MW01 had higher concentrations at shallower depths, while DP01 had higher concentrations at deeper depths.

The TPH-g and TPH-d results support the 1996 reported finding that the lube rack area is the apparent source of contamination (PWC 1996). The low detections of TPH-g and TPH-d in the soil sample collected at 25 feet bgs at location MW07 may be indications of TPH in groundwater, because this soil sample was collected slightly below the water table (23 feet bgs). The detections of TPH-g at a similar concentration as MW07 in the deepest soil samples collected at locations DP02 and DP03 may also have resulted from groundwater impacts in the capillary fringe.

4.4.2 Volatile Organic Compounds

Most of the VOCs detected in soil samples were petroleum-related VOCs rather than chlorinated VOCs. Table 4-5 lists the results for all soil samples for key VOCs, such as

BTEX, MTBE (no detections), trimethylbenzenes (highest concentrations of any VOCs), and 1,2-DCA (historical anti-knock fuel additive). Figure 4-4 identifies the soil sampling results that exceeded screening criteria. Figure 4-6 identifies the soil sampling results for three selected VOCs for selected borings along the A-A' cross section.

Petroleum-Related VOCs

The highest concentrations of 18 VOCs were adjacent to the lube rack, either at sampling location DP01 or MW01. At DP01, on the northwest edge of the lube rack, 1,2,4-trimethylbenzene (TMB) was detected at the highest concentration of any VOC at this site (40,500 $\mu\text{g}/\text{kg}$ at 15 feet bgs). The analyte 1,3,5-TMB, BTEX, and other petroleum-related VOCs (such as isopropylbenzene, sec-butylbenzene, and tert-butylbenzene) were also detected in this same sample and at similar concentrations down to the water table. As indicated in Table 4-5, three VOCs exceeded their screening criteria at this sampling location: 1,2,4-TMB in the samples at 15, 20, and 25 feet bgs; 1,3,5-TMB at 25 feet bgs; and benzene at 25 feet bgs. The concentrations of VOCs at this sampling location were lowest at 5 and 10 feet bgs.

1,2,4-TMB also exceeded screening criteria in three other samples: at sampling location MW01 (south edge of lube rack) at 5 and 10 feet bgs, and at sampling location DP02 (north edge of lube rack) at 25 feet bgs. At both of these sampling locations, other petroleum-related VOCs were detected in the same samples but at concentrations that did not exceed screening criteria. At MW01, a similar pattern to TPH was found: the two shallowest samples had the highest concentrations, while the deeper samples had lower concentrations. At DP02, the three shallowest samples had virtually no VOC detections, but the deepest sample (25 feet bgs) had 1,2,4-TMB and ethylbenzene, suggesting that groundwater contamination may be the source of these results in soil. The same could be true at MW07, where 1,3,5-TMB and ethylbenzene and four other VOCs were detected in the sample slightly below the water table in a downgradient location, similar to TPH results discussed in Section 4.4.1.

The VOCs identified at the site were representative of constituents that have been historically found in fuels.

1,2-DCA

1,2-DCA was detected in 8 of the 45 samples at estimated concentrations ranging from 1 to 12 µg/kg in six borings (DP02, DP03, DP09, DP11, MW01, and MW07). All detections were below the screening criteria (350 µg/kg).

The maximum concentration reported, 12 µg/kg, was collected at a depth of 25 feet bgs at MW01; the sample from 20 feet bgs had no 1,2-DCA reported, although the sample at 15 feet bgs had a reported 1,2-DCA concentration of 3 µg/kg.

The detections of 1,2-DCA in soil did not show a pattern throughout the site. Some were located near the lube rack, others were not. Some were located in one or two samples from a boring, while the other samples from that boring showed no detections of 1,2-DCA. The reported concentrations were lower than the previous maximum concentration of 18.1 µg/kg that had been reported in 1996 (PWC 1996).

The analyte 1,2-DCA was an historical fuel additive to scavenge (i.e., reduce) lead (EPA 1992b, ATSDR 1995). Because other chlorinated VOCs such as trichloroethylene (TCE) or perchloroethylene (PCE) that might be mother sources of 1,2-DCA were not detected in soil samples, it does not appear that 1,2-DCA is present at the site as a result of the breakdown of chlorinated solvents. This is important for the NMCRC-LA site, because (as described in the Work Plan, CDM Federal 1999) if the 1,2-DCA is associated with a petroleum-based hydrocarbon product (i.e., not a solvent), then the site can be addressed as a non-CERCLA site.

Others

Methylene chloride was originally reported in several samples but was qualified as not detected during data validation because of the presence of methylene chloride in laboratory method blanks, as discussed in Section 5.3 and Appendix O. Methylene chloride is a common laboratory contaminant (EPA 1994a). Only four sample results remained as methylene chloride detections following data validation activities; however, all were over 100 times below the screening criteria.

Acetone was reported in 16 of the 45 soil samples, but all were more than 1000 times below the screening criteria. 2-Butanone (i.e., methyl ethyl ketone [MEK]) was reported in 14 of the 45 soil samples, but all over 10,000 times below the screening criteria. Both acetone and MEK are common laboratory contaminants (EPA 1994a).

4.4.3 Semivolatile Organic Compounds

A total of 13 SVOCs were detected in one or more samples at the NMCRC-LA site. None were detected in more than 7 of the 45 soil samples. Sample results are summarized in Table 4-6.

The SVOCs detected most frequently and at the highest concentrations were naphthalene and 2-methylnaphthalene. These two SVOCs are constituents of fuels (SWRCB 1987). The highest concentrations were detected at sampling location DP01 at 15 feet bgs. They were detected in the other samples at this boring location, but at lower concentrations. None exceeded screening criteria. Other detections of these two analytes occurred at MW01 in the two shallowest samples (5 and 10 feet bgs) and at DP02 at 25 feet bgs. These results correlate strongly with TPH and VOCs results.

Other polynuclear aromatic hydrocarbon (PAHs) were only detected at sampling location MW02 in samples collected at 5 and 10 feet bgs. The concentration of benzo(a)pyrene of 180J

µg/kg was the only result to exceed its screening criteria (62 µg/kg). Because this sampling location was located beneath the vehicle maintenance building and was associated with the highest site concentration of TPH-oil but not TPH-gasoline, it is likely that these results were not associated with the fuels detected in soil at the lube rack.

Only one other SVOC, bis-2-ethylhexylphthalate (BEHP), was identified in soil at the site. Bis-2-ethylhexylphthalate is a common laboratory contaminant and several other soil samples that had been originally reported as detected were qualified as not detected during data validation activities, as discussed in Section 5.3 and Appendix O. Five of the 45 samples had BEHP detections after data validation activities, with no obvious site pattern. All reported concentrations were more than 10 times lower than the screening criteria.

The average regional background concentration of B(a)P equivalents in Southern California soils is 900 µg/kg (Tetra Tech, 1996). This value was estimated from statistical evaluation of analytical results for 184 samples at 20 different former manufactured gas plant (MGP) sites, which have PAHs as the primary contaminant of concern, in Southern California area (Tetra Tech, 1996).

4.4.4 Polychlorinated Biphenyls

Aroclor 1260 was the only PCB mixture reported in the analytical results (see Table 4-6). It was reported in all four soil samples at sampling location MW02, located beneath the vehicle maintenance building (at depths of 5, 10, 21 and 26 feet bgs). The highest concentration reported, 21 µg/kg, was at a depth of both 5 and 10 feet bgs. The Aroclor 1260 concentrations decreased with increasing depth. None of the concentrations reported at this site exceeded the residential soil PRG of 220 µg/kg for Aroclor 1260.

4.4.5 Metals

Metals results are identified in Appendix J. All metals identified at the site were below residential soil preliminary remediation goals (PRGs), with the exception of arsenic and iron as well as chromium in one sample. Arsenic and iron exceeded residential PRGs in most

samples, but site results were similar to background sample results (for arsenic) and iron was analyzed only because it is commonly used in background assessment geochemical analyses, as discussed in Section 4.3. So, these results most likely represent natural background levels.

All arsenic results ranged from 0.64 to 9.8 mg/kg; the residential PRG is 0.39 mg/kg and the industrial PRG is 2.7 mg/kg. There was no pattern to arsenic results, with many background results among the higher results. All detections (64 of the 69 samples analyzed) had reported concentrations above the PRG of 0.39 mg/kg, including samples taken from “background” locations. It is likely that “naturally occurring” background concentrations for arsenic in this area are normally greater than 0.39 mg/kg, as discussed in Section 4.3.

Iron was analyzed for only because it is considered a natural background metal that was to be used in the background metals assessment (Section 4.3). As with arsenic, there was no pattern to the iron results, with many samples from background locations away from the lube rack showing iron concentrations above the PRG screening criteria.

Five metals were identified as possibly above background levels in the source area: chromium, cobalt, molybdenum, nickel, and vanadium. These metals were used in the HHRA (Section 7).

Organic lead was not detected in any soil samples.

4.4.6 Fate and Transport Parameters

Table 4-7 summarizes sample results for various fate and transport analyses. These results are used in Section 6 to assess the fate and transport of contaminants at this site.

4.4.7 Soil Leachability Tests

Two leachability tests were performed on selected samples. The first, the California WET, uses an acid to simulate leaching that might occur in landfills. The second, SPLP, is used to simulate effects of rainwater infiltration.

These two tests were primarily performed to assess whether the soil IDW generated during sampling activities would be considered hazardous waste. These results are also used to provide limited information about the potential transport of contaminants in the subsurface, as discussed in Section 6.

The results indicate that some organic compounds were leached, typically resulting in concentrations 10 to 100 times lower than detected in soil samples (e.g., soil concentration 150 mg/kg, leachate concentration 10 μ g/L). Appendix O contains analytical results for all samples.

4.4.8 Nature and Extent of Contamination

TPH, VOC, and certain SVOCs results all indicate the major area of contamination is in the lube rack area. These results were all indicative of fuel contamination. Samples collected at 15 feet bgs and below tended to have the highest concentrations, but at MW01 the samples at 5 and 10 feet bgs had the highest concentrations. The depth of the bottom of the former gasoline UST is unknown. Fuel contamination exists in soil samples collected down to the water table and has reached groundwater, as discussed in Section 4.5 below.

Beneath the vehicle maintenance building, PCBs and PAHs were detected in sampling location MW02. Phase II sample results collected from borings approximately 20 feet to the northwest and northeast did not identify PCBs or PAHs (Table 4-6), so the extent of impacts appears to be limited. Furthermore, PCB results were over ten times below the screening criteria (see

Table 4-6). Only one PAH result exceeded a screening criteria and it is located below the vehicle maintenance building that has a concrete floor.

4.5 RESULTS OF GROUNDWATER ANALYSES

This section summarizes the results of chemical analyses of groundwater samples collected during the Phase I (November 1999) and Phase II (January 2000) field investigations. The groundwater samples were analyzed for TPH, VOCs, SVOCs, PCBs, metals (total and dissolved), selected general chemistry parameters, and fate and transport parameters. The sampling results for these analytical categories are summarized and discussed individually in the following sections (see Appendix O for data validation reports for the groundwater samples). The nature and extent of contamination are then discussed in Section 4.5.8 below. Table 4-8 summarizes statistics for the groundwater samples collected at the NMCRC-LA site. Figure 4-7 identifies the groundwater sampling results that exceeded screening criteria.

To evaluate potential groundwater quality impacts, the organic compounds that were detected (primarily VOCs) and the metals that were detected above background concentrations were compared to the State of California Maximum Contaminant Levels (MCLs). For those analytes for which a MCL is not established, the EPA Region IX PRGs for tap water (EPA 1999) were used as the screening levels for this investigation.

4.5.1 Total Petroleum Hydrocarbons

TPH results for groundwater samples are summarized in Table 4-9. Figure 4-8 identifies the groundwater sampling results for TPH for sampling locations along the A-A' cross section.

Groundwater samples were analyzed for TPH in the gasoline range, diesel range, and motor oil range (TPH-g, TPH-d, and TPH-oil, respectively). As identified in Section 5.3 and discussed in Appendix O, TPH results reported at low concentrations should be used with caution because it may have been a laboratory artifact, rather than actually being present in a

site sample. In particular, TPH-g results less than approximately 0.25 mg/L, TPH-d results less than approximately 0.35 mg/L, and TPH-oil results less than approximately 0.35 mg/L should be used with caution.

Field crews did not observe any free product, any oily sheen, or any odor when collecting groundwater samples.

The highest TPH concentrations were detected near the lube rack and former gasoline UST. For TPH-g, the three highest concentrations were located adjacent to the lube rack at sampling locations GG01, GG02, and GG03. Samples collected beneath the vehicle maintenance building had the next highest concentrations. The same pattern was identified for TPH-d, except that concentrations were lower than for TPH-g. For TPH-oil, there were fewer detections and at even lower concentrations. Because field QC samples had TPH-oil concentrations at similar concentrations, all TPH-oil concentrations results should be used with caution because they may be laboratory or field sampling artifacts.

There is no concentration established as screening criteria for TPH.

4.5.2 Volatile Organic Compounds

Many of the VOCs detected in groundwater samples were petroleum-related VOCs. The analyte 1,2-DCA was also detected in many samples. Table 4-10 lists the results for all groundwater samples for key VOCs, such as BTEX, MTBE (no detections), trimethylbenzenes (highest concentrations of any VOCs), and 1,2-DCA (historical anti-knock fuel additive). Figure 4-7 identifies the groundwater sampling results for analytes that exceeded screening criteria. Figure 4-9 identifies the groundwater sampling results for three selected VOCs for selected groundwater sampling locations along the A-A' cross section.

Petroleum-Related VOCs

The highest concentrations of 13 of the 16 detected VOCs were adjacent to the lube rack at sampling location GG01 (same location as the highest soil VOC concentrations). At GG01, on the northwest edge of the lube rack, m/p-xylenes were detected at the highest concentration of any VOC at this site (1590 $\mu\text{g/L}$). The VOC 1,2,4-TMB, detected in soil at a concentration higher than any other VOC, was the analyte detected at the second highest concentration in groundwater (1130 $\mu\text{g/L}$). BTEX, 1,3,5-TMB, and other petroleum-related VOCs (such as isopropylbenzene, sec- and n-butylbenzene, and naphthalene) were also detected at their highest concentrations in this same sample.

As indicated in Table 4-8 and 4-10, eight petroleum VOCs exceeded their screening criteria. These included the following:

- Benzene (4 sampling locations, adjacent to or near the lube rack) at a maximum of 588 $\mu\text{g/L}$ compared to the MCL of 1 $\mu\text{g/L}$;
- Toluene, ethylbenzene, and total xylenes (at GG01 adjacent to the lube rack) at a maximum of 313, 711, and 2118 (i.e., 1590 m/p-xylenes + 528 o-xylene) $\mu\text{g/L}$ compared to their respective MCLs of 150, 700, and 1750 $\mu\text{g/L}$;
- 1,2,4-TMB and 1,3,5-TMB (three locations adjacent to or near the lube rack) at a maximum of 1130 and 320 $\mu\text{g/L}$, compared to their common PRG of 12 $\mu\text{g/L}$ (no MCL exists);
- Naphthalene (three locations adjacent to or near the lube rack) at a maximum of 120 $\mu\text{g/L}$ compared to its PRG of 6.2 $\mu\text{g/L}$ (no MCL exists); and
- N-propylbenzene (at GG01 adjacent to the lube rack) at a maximum of 304 $\mu\text{g/L}$ compared to its PRG of 61 $\mu\text{g/L}$ (no MCL exists).

Figure 4-10 indicates the approximate isoconcentration lines of benzene in groundwater at this site. Similarly, Figure 4-11 indicates the approximate isoconcentration lines of total trimethylbenzenes in groundwater at this site. Both figures spatially indicate that the highest concentrations were in the lube rack and former gasoline UST area, with decreasing and ultimately non-detect concentrations at further distances.

1,2-DCA

1,2-DCA was detected in more groundwater samples than the other VOCs. It was detected in 11 of the 17 groundwater samples and at 9 of the 14 sampling locations (three wells were sampled twice).

The maximum concentration reported, 27 $\mu\text{g/L}$ (28 $\mu\text{g/L}$ in its duplicate), was collected from well MW01 adjacent to the lube rack. Figure 4-12 indicates the approximate isoconcentration line boundaries of 1,2-DCA in groundwater at this site. Figure 4-12 indicates a similar spatial pattern as Figures 4-10 and 4-11 for benzene and total trimethylbenzenes, except that 1,2-DCA was detected further downgradient (but at lower concentrations).

The analyte 1,2-DCA was an historical common fuel additive used to scavenge (i.e., reduce) lead (EPA 1992b, ATSDR 1995). Because other chlorinated VOCs such as TCE that might be mother sources of 1,2-DCA were generally not detected in groundwater samples, it does not appear that 1,2-DCA is present at the site as a result of the breakdown of chlorinated solvents. This is important for the NMCRC-LA site, because (as described in the Work Plan, CDM Federal 1999) if the 1,2-DCA is associated with a petroleum-based hydrocarbon product, then the site can be addressed as a non-CERCLA site. It should be noted that PCE was reported in 3 groundwater samples, but at a maximum of 2 $\mu\text{g/L}$, which is 14 times lower than the highest 1,2-DCA detection.

Others

Chloroform was reported in 6 of the 17 groundwater samples, at a maximum concentration of 10 $\mu\text{g/L}$. There is no federal or state MCL established for chloroform; however, each of six detections exceeded the PRG of 0.16 $\mu\text{g/L}$. Chloroform was not a suspected contaminant of concern from the former gasoline UST or drums of waste stored above the lube rack in the late 1980s. In addition, the two highest detections were in the two background wells and the other

four detections were in groundwater beneath the vehicle maintenance building, not adjacent to the lube rack and former gasoline UST area or downgradient as indicated in Figure 4-7.

4.5.3 Semivolatile Organic Compounds

As indicated in Table 4-11, only three SVOCs were detected in groundwater samples: naphthalene, 2-methylnaphthalene, and di-n-butyl phthalate.

Naphthalene is also detectable as a VOC and was discussed in Section 4.5.2. For the SVOC Method 8270C analysis, naphthalene was detected in three groundwater samples, at concentrations of 76, 64, and 19 $\mu\text{g/L}$ compared to a PRG of 6.2 $\mu\text{g/L}$ (no MCL exists). These three detections correlated well with the three highest naphthalene concentrations that had been identified by the VOC Method 8260B analysis. These three samples were located adjacent to the lube rack and former gasoline UST area or under the vehicle maintenance building.

2-Methylnaphthalene was detected in the same three samples as naphthalene was, but at lower concentrations (26, 17, and 12 $\mu\text{g/L}$). No MCL or PRG exists for this analyte. Both naphthalene and 2-methylnaphthalene are constituents of gasoline (SWRCB 1987).

Di-n-butyl phthalate was reported in one groundwater sample, at sampling location GG09, at a concentration of 19 $\mu\text{g/L}$. Phthalates are common laboratory contaminants and were not suspected site contaminants. Di-n-butyl phthalate was detected in field QC samples (two equipment rinsates and one field blank) at concentrations up to 3 $\mu\text{g/L}$, so it is possible that this detection may have been caused by laboratory contamination.

4.5.4 Polychlorinated Biphenyls

No PCBs were detected in any of the groundwater samples.

4.5.5 Metals

This section discusses dissolved metals results, total metals results, and organic lead results.

4.5.5.1 Dissolved Metals

Table 4-12 presents groundwater sample results for filtered (dissolved) metals. Four sample results exceeded screening criteria, as identified below:

- Antimony in the groundwater grab sample from location MW07 located downgradient of the source area ($11.3 \mu\text{g/L}$ compared to MCL of $6 \mu\text{g/L}$). The source area samples and other downgradient samples did not exceed the MCL;
- Iron in the groundwater grab sample from location GG02 in the source area ($784 \mu\text{g/L}$ compared to the secondary MCL of $300 \mu\text{g/L}$). The other source area samples and downgradient samples did not exceed the MCL;
- Lead in the groundwater grab sample from location GG01 at the suspected center of the source area (compared to the MCL of $15 \mu\text{g/L}$). The other source area samples and downgradient samples did not exceed the MCL; in fact, lead was detected in only one other groundwater sample; and
- Molybdenum in the groundwater sample from well MW06 located downgradient ($344 \mu\text{g/L}$ compared to the residential PRG of $180 \mu\text{g/L}$; no MCL exists for molybdenum). Groundwater from the source area wells and other site wells were significantly lower.

As discussed in Section 4.3, many of the metals results appear to be at background levels. Barium, cobalt, lead, nickel, and zinc appeared to be possibly above background levels, although the limited number of data points limited this evaluation. These five metals, plus antimony and molybdenum because an MCL or PRG was exceeded, were included in HHRA (Section 7).

4.5.5.2 Total Metals

Metals were analyzed in both unfiltered and filtered groundwater samples. Unfiltered (total) metals results were generally much higher than filtered results. Unfiltered groundwater

contained a relatively high degree of turbidity, meaning suspended solids (soil particles) were entrained in the groundwater. This presents difficulties and biases in interpreting and analyzing unfiltered groundwater sample results; therefore, filtered groundwater sample results that represent dissolved concentrations are more representative of actual groundwater conditions.

4.5.5.3 Organic Lead

Organic lead was not detected in any samples except in one sample where its result is considered highly suspect as discussed in Section 5.3.

4.5.6 General Chemistry

General chemistry results are presented for each groundwater sample in Table 4-13. General chemistry parameters are used for assessing background water quality conditions, as well as for understanding and assessing fate and transport processes (Section 6).

General chemistry results were generally similar for most groundwater samples collected at this site. TDS results ranged from 962 to 2730 mg/L, indicating that groundwater beneath the site is generally not well suited for drinking water (the secondary MCL [SMCL] for TDS is 500 mg/L). Several of the samples exceeded the SMCL of 250 mg/L for chloride and 250 mg/L for sulfate.

4.5.7 Biodegradation Related Parameters

Groundwater sample results for parameters that are related to biodegradation are summarized in Table 4-14. These results are used in Section 6 for assessing fate and transport of contaminants.

4.5.8 Nature and Extent of Contamination

Groundwater contamination has been identified in the vicinity of the former gasoline UST and lube rack area. The contamination appears to be primarily petroleum hydrocarbons from gasoline. TPH in the gasoline range was detected at a higher concentration than TPH in the diesel range. Individual petroleum-related VOC analytes that exceeded screening criteria in groundwater in this area were 1,2,4-TMB, ethylbenzene, benzene, 1,3,5-TMB, toluene, n-propylbenzene, and naphthalene. The presence of 1,2-DCA above its screening criteria is also most likely related to the former gasoline UST for three reasons: (1) 1,2-DCA was an historical gasoline additive, (2) chlorinated solvents such as TCE and PCE were not detected in most groundwater samples, and (3) the spatial pattern of 1,2-DCA at the site was similar to the petroleum hydrocarbons.

Chloroform was detected above the screening criteria in six groundwater samples; however, its highest concentrations were in the background wells, not in any groundwater samples at the former gasoline UST/lube rack area. Therefore, it is likely not a contaminant from the source being investigated for this project.

The highest TPH and VOCs concentrations were centered between the lube rack and the vehicle maintenance building at sampling location DP01, which is the same location identified during the 1996 investigation as the most likely source area. Groundwater samples from upgradient wells (MW03, MW04B) were not impacted by petroleum hydrocarbons. Most analytes in the farthest downgradient wells (MW05, MW06) were not detected, except for very low concentrations of a small number of analytes. 1,2-DCA was detected in one of the two wells located furthest downgradient, although at a concentration 9 times lower than in the source area.

Table 4-1
Groundwater Flow Estimates and Assumptions for the Range of Soil Types, NMCRC-LA

Location	Soil Type	K (ft/day)	Effective Porosity	I (ft/ft)	Velocity (ft/day)	(ft/year)	% of aquifer
Near Source Area	Sand	0.4	0.35	0.003	0.0034	1.25	20%
MW02, MW01, MW07	Sandy clay	0.004	0.20	0.003	0.00006	0.02	80%
Downgradient	Sand	0.4	0.35	0.028	0.032	11.7	20%
(MW05, MW06)	Sandy clay	0.004	0.20	0.028	0.00056	0.20	80%

Notes:

K = hydraulic conductivity
I = hydraulic gradient
Ft = feet

Table 4-2
Background Metals Results NMCRC-LA, 1999-2000

Analyte	No. of Samples	No. of Detections	Detection Frequency (%)	Minimum Conc. (mg/kg)	Maximum Conc. (mg/kg)	Sampling Location of Maximum	Depth of Max. (feet bgs)	Area Group of Max.	Data Distribution Type	Above Background at Source(a)
Soil										
Aluminum	82	82	100	3420	20,200	DP11	5	Source	Normal	No (c)
Antimony	82	12	15	0.3	2.9	DP10	5	Source	Lognormal	No
Arsenic	82	75	91	0.64	9.8	MW07	25	Downgradient	Normal	No
Barium	82	82	100	30.5	435	DP03	5	Source	Lognormal	No
Beryllium	82	19	23	0.11	0.55	DP06	11	Background	Lognormal	No
Cadmium	82	54	66	0.042	5	MW06	20	Downgradient	Lognormal	No
Chromium	82	82	100	4.5	37.1	DP05	5	Background	Normal	Yes
Cobalt	82	82	100	2.9	23.8	DP11	16	Source	Lognormal	Yes
Copper	82	82	100	4.8	35.2	DP05	5	Background	Normal	No
Iron	82	82	100	5250	34,600	DP01	10	Source	Normal	No (c)
Lead	82	80	98	2.7	37	MW06	5	Downgradient	Lognormal	No
Mercury	82	50	61	0.01	0.15	MW05	10	Downgradient	(b)	No
Molybdenum	82	32	39	0.79	6.1	MW07	25	Downgradient	Lognormal	Yes
Nickel	82	82	100	5.6	39.2	DP11	16	Source	Normal	Yes
Selenium	82	38	46	0.19	9.7	DP11	10	Source	Lognormal	No
Silver	82	2	2	0.065	0.76	MW01	5	Source	(e)	No
Thallium	82	2	2	0.47	1.4	DP06	5	Background	(e)	No
Vanadium	82	82	100	7.8	82	DP03	18	Source	Normal	Yes
Zinc	82	82	100	13.2	102	DP04	5	Background	Normal	No
Groundwater (Filtered) (d)										
Aluminum	16	2	13	47	131	MW07		Downgradient	Lognormal	No
Antimony	16	3	19	2.6	11.3	MW07		Downgradient	(b)	No
Arsenic	16	3	19	5.2	11.2	GG03		Source	(b)	No
Barium	16	16	100	14.6	445	GG02		Source	(b)	Yes

Table 4-2 (continued)
Background Metals Results NMCRC-LA, 1999-2000

Analyte	No. of Samples	No. of Detections	Detection Frequency (%)	Minimum Conc. (µg/L)	Maximum Conc. (µg/L)	Sampling Location of Maximum	Depth of Max. (feet bgs)	Area Group of Max.	Data Distribution Type	Above Background at Source(a)
Groundwater (Filtered) (d) (continued.)										
Beryllium	16	0	0	--	--	--	--	--	NA	No
Cadmium	16	1	6	0.35	0.35	MW07		Downgradient	(b)	No
Chromium	16	7	44	1.3	4.3	GG03, MW05		Source, Downgradient	Normal	No
Cobalt	16	6	38	0.9	16.5	GG03		Source	Lognormal	Yes
Copper	16	13	81	5.7	12.1	MW07		Downgradient	Normal	No
Iron	16	9	56	11	784	GG02		Source	Lognormal	No
Lead	16	2	13	6.9	16.8	GG01		Source	(b)	Yes
Mercury	16	12	75	0.16	0.56	MW05		Downgradient	Lognormal	No
Molybdenum	16	16	100	17.3	344	MW06		Downgradient	Lognormal	No
Nickel	16	10	63	3.4	41.2	GG03		Source	Lognormal	Yes
Selenium	16	5	31	13.6	22.6	GG02		Source	Normal	No
Silver	16	1	6	3.4	3.4	MW02		Source	(b)	No
Thallium	16	0	0	--	--	--		--	NA	No
Vanadium	16	2	13	3.7	4.4	MW07		Downgradient	Lognormal	No
Zinc	16	15	93	7.2	24.9	GG01		Source	Lognormal	Yes

Notes:

- a See Appendix J for details on statistical testing and results.
- b Did not resemble either a normal or lognormal distribution.
- c Aluminum and iron were considered background metals as discussed in Appendix J.
- d The groundwater grab sample from GG08 was not included due to relatively high turbidity even after filtering.
- e Frequency of detection not high enough to analyze

NMCRC-LA = Naval and Marine Corps Reserve Center-Los Angeles
 No. = Number
 NA = Not Applicable (because of no detections)

Table 4-3
Summary Statistics for Soil Sample Results NMCRC-LA, 1999-2000

Analytical Parameter	No. of Samples ^(c)	No. of Detections	Maximum Concentration	Sample ID	Screening Criteria Residential PRG	No. of Detections above Screening Criteria	Comments
TPH-Diesel (mg/kg)	45	26	180	99RC-DP01-S-1-15	100 ^(a)	3	
TPH-Gasoline (mg/kg)	45	28	519	99RC-MW01-S-1-10	100 ^(a)	5	
TPH-Motor Oil (mg/kg)	45	6	65	99RC-DP03-S-1-18	1000 ^(a)	none	
VOCs ^(b) (µg/kg)							
1,2,4-Trimethylbenzene	45	13	40,500	99RC-DP01-S-1-15	5700	7	
1,2-Dichloroethane	45	8	12	99RC-MW01-S-1-25	350	none	
1,3,5-Trimethylbenzene	45	10	27,200	99RC-DP01-S-1-25	21,000	1	
2-Butanone (MEK)	45	14	129	99RC-DP01-S-1-15	7,300,000	none	
Acetone	45	16	290	99RC-DP01-S-1-20	1,600,000	none	
Benzene	45	7	698	99RC-DP01-S-1-25	670	1	
Carbon Disulfide	45	3	36	99RC-MW01-S-1-25	360,000	none	
Ethylbenzene	45	15	9810	99RC-DP01-S-1-25	230,000	none	
Isopropylbenzene	45	13	1580	99RC-DP01-S-1-15	160,000	none	
M/P-Xylene	45	9	35,000	99RC-DP01-S-1-25	210,000	none	
Methylene Chloride	45	4	54	99RC-DP01-S-1-10	8900	none	
Naphthalene	45	13	4760	99RC-MW01-S-1-10	56,000	none	
N-Butylbenzene	45	1	4	99RC-MW01-S-1-20	140,000	none	
N-Propylbenzene	45	5	960	99RC-DP01-S-1-25	140,000	none	
O-Xylene	45	6	12,600	99RC-DP01-S-1-25	210,000	none	
P-Isopropyltoluene	45	10	891	99RC-DP01-S-1-15	NE	none	
Sec-Butylbenzene	45	11	831	99RC-DP01-S-1-15	110,000	none	
Tert-Butylbenzene	45	1	2370	99RC-DP01-S-1-15	130,000	none	
Tetrachloroethene	45	1	1	00RC-MW06-S-1-15	5700	none	
Toluene	45	6	5620	99RC-DP01-S-1-25	520,000	none	
SVOCs ^(b) (µg/kg)							
2-Methylnaphthalene	45	7	3100	99RC-DP01-S-1-15	NE	none	
Benz(a)anthracene	45	1	140J	99RC-MW02-S-1-10	620	none	
Benzo(a)pyrene	45	2	180	99RC-MW02-S-1-10	62	1	
Benzo(b)fluoranthene	45	2	290J	99RC-MW02-S-1-10	620	none	

Table 4-3 (continued)
Summary Statistics for Soil Sample Results NMCRC-LA, 1999-2000

Analytical Parameter	No. of Samples ^(c)	No. of Detections	Maximum Concentration	Sample ID	Screening Criteria Residential PRG	No. of Detections above Screening Criteria	Comments
Benzo(g,h,i)perylene	45	1	82J	99RC-MW02-S-1-10	NE	none	none
Bis(2-Ethylhexyl) Phthalate	45	4	2500	00RC-DP10-S-1-10	35,000	none	none
Chrysene	45	2	220J	99RC-MW02-S-1-10	62,000	none	none
Fluoranthene	45	2	300J	99RC-MW02-S-1-10	2,300,000	none	none
Indeno(1,2,3-cd) Pyrene	45	1	82J	99RC-MW02-S-1-10	620	none	none
Naphthalene	45	7	7300	99RC-DP01-S-1-15	56,000	none	none
Phenanthrene	45	2	200J	99RC-MW02-S-1-10	NE	none	none
Pyrene	45	2	370J	99RC-MW02-S-1-10	2,300,000	none	none
PCBs^(b) (µg/kg)							
Aroclor 1260	45	4	21	99RC-MW02-S-1-05	220	none	none
				99RC-MW02-S-1-10		none	
Organic Lead (mg/kg)	69	0	--	--	0.0061	none	none
Metals^(b) (mg/kg)							
Aluminum	69	69	20,200	00RC-DP11-S-1-5	76,000	none	none
Antimony	69	11	3.5J	00RC-DP10-S-1-5	31	none	none
Arsenic	69	64	9.8	00RC-MW07-S-1-25	0.39	64 (d)	64 (d)
Barium	69	69	435	99RC-DP03-S-1-05	5400	none	none
Beryllium	69	16	0.55	99RC-DP06-S-1-11	150	none	none
Cadmium	69	47	5	00RC-MW06-S-1-20	9	none	none
Chromium	69	69	30.4	99RC-DP01-S-1-10	30	1	1
Cobalt	69	69	23.8	00RC-DP11-S-1-16	4700	none	none
Copper	69	69	34.4	99RC-MW03-S-1-15	2900	none	none
Iron	69	69	34,600	99RC-DP01-S-1-10	23,000	53 (d)	53 (d)
Lead	69	68	37	00RC-MW06-S-1-5	400	none	none
Mercury	69	42	0.15J	99RC-MW05-S-1-10	23	none	none
Molybdenum	69	25	6.1	00RC-MW07-S-1-25	390	none	none

Table 4-3 (continued)
Summary Statistics for Soil Sample Results NMCRC-LA, 1999-2000

Analytical Parameter	No. of Samples ^(c)	No. of Detections	Maximum Concentration	Sample ID	Screening Criteria Residential PRG	No. of Detections above Screening Criteria	Comments
Nickel	69	69	39.2	00RC-DP11-S-1-16	150	none	
Selenium	69	33	9.7	00RC-DP11-S-1-10	390	none	
Silver	69	2	0.76	99RC-MW01-S-1-05	390	none	
Thallium	69	2	1.4	99RC-DP06-S-1-05	NE	none	
Vanadium	69	69	79.3	99RC-DP02-S-1-18	550	none	
Zinc	69	69	85.61	99RC-DP01-S-1-10	23,000	none	

Notes:

- (a) Screening levels are from the Los Angeles Regional Water Quality Control Board, Interim Site Assessment & Cleanup Guidebook, Table 4-1, 1996.
- (b) If not listed in this table, the remaining analytes were not detected.
- (c) This table does not include field QC samples such as field duplicates.
- J = Estimated Concentration
- SVOCs = Semivolatile Organic Compounds
- VOCs = Volatile Organic Compounds
- TPH = Total Petroleum Hydrocarbons
- MEK = Methyl Ethyl Ketone
- mg/kg = Milligrams Per Kilogram
- µg/kg = Micrograms Per Kilogram
- NMCRC-LA = Naval and Marine Corps Reserve Center-Los Angeles
- NE = Screening levels have not been established
- No. = Number
- PCBs = Polychlorinated Biphenyls
- PRG = Screening levels are from the U.S. Environmental Protection Agency Region IX Preliminary Remediation Goals, October 1, 1999 for residential soil.

Table 4-4
Summary of Soil Analytical Results—TPH, NMCRC-LA, 1999-2000

Boring No.	Sampling Date	Sample Depth feet bgs	TPH Gasoline	TPH Diesel	TPH Motor Oil
			mg/kg	mg/kg	mg/kg
			Screening Criteria		
			100 ^(a)	100 ^(a)	1000 ^(a)
MW01	11/1/99	5	263 J	97 (b)	ND
	11/1/99	10	519	120 (b)	ND
	11/1/99	20	0.3 J	11 J	9 J
	11/1/99	25	11 J	11 J (b)	ND
MW02	11/9/99	5	ND	ND	ND
	11/9/99	10	ND	30	45
	11/9/99	21	ND	ND	ND
	11/9/99	26	ND	ND	ND
MW06	1/25/00	5	ND	ND	ND
	1/25/00	10	ND	ND	ND
	1/25/00	15	ND	ND	ND
dup	1/25/00	15	ND	ND	ND
	1/25/00	20	ND	ND	ND
MW07	1/24/00	5	0.4 J (c)	ND	ND
	1/24/00	12	0.5 J	ND	ND
	1/24/00	19	0.5 J (c)	ND	ND
	1/24/00	25	13	15 (d)	ND
DP01	11/3/99	5	15 (e)	14 (f)	ND
	11/3/99	10	29 (e)	35 (f)	ND
	11/3/99	15	101 (e)	180 (g)	ND
	11/3/99	20	133 J (e)	110 J (g)	ND
dup	11/3/99	20	235 J (e)	43 J (g)	ND
	11/3/99	25	55	66 (g)	ND
DP02	11/2/99	5	ND	2 J	ND
	11/2/99	12	ND	2 J	ND
	11/2/99	18	ND	ND	ND
	11/2/99	25	14 (f)	26 (h)	ND
DP03	11/2/99	5	ND	ND	ND
	11/2/99	12	ND	5 J	6 J
	11/2/99	18	ND	26 J	ND
dup	11/2/99	18	ND	ND	ND UJ
	11/2/99	25	14 (f)	13 (h)	ND
DP08	1/25/00	5	ND	1 J	ND
	1/25/00	12	ND	2 J	3 J
	1/25/00	20	ND	ND	ND
	1/25/00	24	ND	1 J	2 J
dup	1/25/00	24	ND	ND UJ	ND UJ

Table 4-4 (continued)
Summary of Soil Analytical Results—TPH, NMCRC-LA, 1999-2000

Boring No.	Sampling Date	Sample Depth feet bgs	TPH Gasoline	TPH Diesel	TPH Motor Oil
			mg/kg	mg/kg	mg/kg
			Screening Criteria		
			100 ^(a)	100 ^(a)	1000 ^(a)
DP09	1/24/00	5	0.5 J (c)	ND	ND
	1/24/00	12	0.4 J (c)	ND	ND
	1/24/00	19	0.5 J (c)	10 J (i)	ND
	1/24/00	25	0.8 J (c)	2 J	ND
DP10	1/26/00	5	0.9 J (c)	ND	ND
	1/26/00	10	0.6 J (c)	2 J	ND
	1/26/00	17	0.6 J (c)	ND	ND
	1/26/00	23	0.6 J (c)	1 J	ND
DP11	1/26/00	5	0.3 J (c)	ND	ND
	1/26/00	10	0.4 J	ND	ND
	1/26/00	16	0.2 J	1 J	ND
	1/26/00	24	0.05 J	ND	ND
dup	1/26/00	24	ND UJ	ND	ND

Notes:

1. All VOC and TPH concentrations detected in soil samples above screening criteria are **BOLDED**
2. As discussed in Appendix L, TPH results at low concentrations should be used with caution because field QC samples had low detections of TPH, indicating possible false positive results reported for site samples
3. From laboratory reports:
 - (a) Los Angeles Regional Water Quality Control Board. Interim Site Assessment and Cleanup Guidebook Table 4-1. 1996
 - (b) Mixture in JP-5/Diesel Range
 - (c) Not a gasoline; chromatogram contained unknown peaks at C9-C11 range
 - (d) Mixture in Jet Fuel Range
 - (e) Not a typical gasoline pattern; peaks in chromatogram correspond to the heavier portion of chain.
 - (f) Mixture Jet Fuel/Kerosene
 - (g) Mixture in gasoline/mineral spirits range.
 - (h) Mixture in fuel/mineral spirits range
 - (i) Not diesel; chromatogram contained unknown peak at C26

Bgs = below ground surface
 DP = direct push
 dup = duplicate
 J = estimated concentration
 mg/kg = milligrams per kilogram
 MW = monitoring well
 ND = not detected
 NMCRC-LA = Naval and Marine Corps Reserve Center-Los Angeles
 TPH = total petroleum hydrocarbons
 UJ = Undetected at an estimated concentration

Table 4-5
Summary of Soil Analytical Results—VOCs, NMCRC-LA 1999-2000

Boring No.	Sample Date	Sample Depth feet bgs	Benzene	Toluene	Ethylbenzene	Xylenes	MTBE	1,2,4-TMB	1,3,5-TMB	1,2-DCA	Other VOCs Detected	
			ug/kg	ug/kg	ug/kg	o- m/p-	ug/kg	ug/kg	ug/kg	ug/kg		
			Screening Criteria									
670 PRG 520,000 PRG 230,000 PRG 210,000 PRG None 5700 PRG 21,000 PRG 350 PRG Above No. Screening Criteria												
MW01	11/1/99	5	ND	51	215	604	1090	ND	26200	978	ND	None 6 (a)
	11/1/99	10	ND	12	520	1050	9290	ND	27500	7396	J 3	None 5 (a)
	11/1/99	20	1 J	ND	1 J	ND	1	ND	8	1 J	ND	None 4 (a)
	11/1/99	25	9	ND	25	ND	7	ND	476	120	12	None 6 (a)
MW02	11/9/99	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	None 0
	11/9/99	10	ND	ND	ND	ND	ND	ND	ND	ND	ND	None 0
	11/9/99	21	ND	ND	ND	ND	ND	ND	ND	ND	ND	None 0
	11/9/99	26	ND	ND	ND	ND	ND	ND	ND	ND	ND	None 0
MW06	1/25/00	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	None 1
	1/25/00	10	ND	ND	ND	ND	ND	ND	ND	ND	ND	None 0
	1/25/00	15	ND	ND	ND	ND	ND	ND	ND	ND	ND	None 0
	1/25/00	20	ND	ND	ND	ND	ND	ND	ND	ND	ND	None 0
MW07	1/24/00	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	None 0
	1/24/00	12	ND	ND	ND	ND	ND	ND	ND	ND	ND	None 0
	1/24/00	19	ND	ND	1 J	ND	ND	ND	ND	ND	2 J	None 2 (a)
	1/24/00	25	ND	ND	200	ND	ND	ND	ND	ND	ND	None 4 (a)
DP01	11/3/99	5	10	ND	973	ND	100	ND	4490	1850	ND	None 6 (a)
	11/3/99	10	23	6	729	110	1280	ND	1050	ND	ND	None 6 (a,b)
	11/3/99	15	279	1330	6560	8140	27200	ND	40500	9747	J	None 8 (a,b)
	11/3/99	20	110 J	703 J	6130 J	7240 J	23900 J	ND	31800	9050	J	None 7 (a,b)
	11/3/99	20	61	468 J	2250 J	585	5380	ND	9860	5550	ND	None 7 (a,b)
	11/3/99	25	698 J	5620	9810	12600	35000	ND	37500	27200	ND	None 6 (a,b)

Table 4-5 (continued)
Summary of Soil Analytical Results—VOCs, NMCRC-LA 1999-2000

Boring No.	Sample Date	Sample Depth feet bgs	Benzene	Toluene	Ethylbenzene	Xylenes	MTBE	1,2,4-TMB	1,3,5-TMB	1,2-DCA	Other VOCs Detected
			ug/kg	ug/kg	ug/kg	o- m/p-	ug/kg	ug/kg	ug/kg	ug/kg	
			Screening Criteria								
670 PRG 520,000 PRG 230,000 PRG 210,000 PRG None 5700 PRG 21,000 PRG 350 PRG Above No. Screening Criteria											
DP02	11/2/99	5	ND	ND	ND	ND	ND	ND	ND	ND	None 1
	11/2/99	12	ND	ND	ND	ND	ND	ND	ND	3 J	None 1
	11/2/99	18	ND	ND	ND	ND	ND	1 J	ND	5 J	None 2 (b)
	11/2/99	25	ND	ND	900 J	ND	ND	9500	ND	ND	None 2
DP03	11/2/99	5	ND	ND	ND	ND	ND	ND	ND	ND	None 0
	11/2/99	12	ND	ND	ND	ND	ND	ND	ND	ND	None 1
	11/2/99	18	ND	ND	ND	ND	ND	ND	ND	ND	None 1
	11/2/99	18	ND	ND	ND	ND	ND	ND	ND	ND	None 1
	11/2/99	25	ND	ND	ND	ND	ND	10	ND	5 J	None 6 (a,b)
DP08	1/25/00	5	ND	ND	ND	ND	ND	ND	ND	ND	None 0
	1/25/00	12	ND	ND	ND	ND	ND	ND	ND	ND	None 0
	1/25/00	18	ND	ND	ND	ND	ND	ND	ND	ND	None 0
	1/25/00	24	ND	ND	ND	ND	ND	ND	ND	ND	None 1
	1/25/00	24	ND	ND	ND	ND	ND	ND	ND	ND	None 1
DP09	1/24/00	5	ND	ND	ND	ND	ND	ND	ND	ND	None 0
	1/24/00	12	ND	ND	ND	ND	ND	ND	ND	ND	None 0
	1/24/00	19	ND	ND	1 J	ND	ND	ND	ND	2 J	None 4
	1/24/00	25	ND	ND	0.7 J	ND	ND	ND	ND	ND	None 4
DP10	1/26/00	5	ND	ND	ND	ND	ND	ND	ND	ND	None 1 (b)
	1/26/00	10	ND	ND	ND	ND	ND	ND	ND	ND	None 1 (b)
	1/26/00	17	ND	ND	ND	ND	ND	ND	ND	ND	None 1 (b)
	1/26/00	23	ND	ND	ND	ND	ND	ND	ND	ND	None 1 (b)

Table 4-5 (continued)
Summary of Soil Analytical Results—VOCs, NMCRC-LA 1999-2000

Boring No.	Sample Date	Sample Depth	Benzene	Toluene	Ethylbenzene	Xylenes	MTBE	1,2,4-TMB	1,3,5-TMB	1,2-DCA	Other VOCs Detected
		feet bgs	ug/kg	ug/kg	ug/kg	o- m/p- ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	
Screening Criteria											
			670 PRG	520,000 PRG	230,000 PRG	210,000 PRG	None	5700 PRG	21,000 PRG	350 PRG	Above Screening Criteria
DP11	1/26/00	5	ND	ND	ND	ND	ND	ND	ND	ND	None 1 (b)
	1/26/00	10	ND	ND	ND	ND	ND	ND	ND	ND	None 1 (b)
	1/26/00	16	ND	ND	ND	ND	ND	ND	ND	ND	None 1 (b)
	1/26/00	24	ND	ND	ND	ND	ND	ND	ND	5 J	None 2 (b)
	1/26/00	24	ND	ND	ND	ND	ND	ND	ND	1 J	None 3 (b)

Notes:

- All VOC concentrations detected in soil samples above screening criteria are **BOLDED**.
- Duplicate results were generally similar to the original sample result
 - Typically n-propylbenzene, sec-butylbenzene, isopropylbenzene (cumene), and naphthalene were detected.
 - 2-Butanone (i.e., methyl ethyl ketone [MEK]) was detected.

bgs = below ground surface
 1,2-DCA = 1,2-dichloroethane
 DP = direct push
 dupl. = duplicate sample
 J = estimated concentration
 ug/kg = micrograms per kilogram
 MTBE = methyl-tert-butyl ether
 MW = monitoring well
 ND = not detected
 NMCRC-LA = Naval and Marine Corps Reserve Center-Los Angeles
 No. = number
 PRG = EPA Region IX residential remediation goals (01 October 1999)
 TMB = trimethylbenzene
 VOCs = volatile organic compounds

Table 4-6
Summary of Soil Analytical Results—Detected SVOCs and PCBs, NMCRC-LA, 1999-2000

Well No. Direct Push	Sample Depth feet bgs	Sample Date	SVOCs			PCBs		
			Screening Level (a)	Analyte	ug/kg Qualifier	Screening Level (a)	Analyte	ug/kg Qualifier
MW01	5	11/1/99	none	2-Methylnaphthalene	645			
			56,000	Naphthalene	614			
	10	11/1/99	none	2-Methylnaphthalene	600			
			56,000	Naphthalene	766			
	25	11/1/99	56,000	Naphthalene	70 J			
MW02	5	11/9/99	62	Benzo(a)pyrene	56 J	220	Aroclor 1260	21 J
			620	Benzo(b)fluoranthene	57 J			
			62000	Chrysene	85 J			
			none	Phenanthrene	72 J			
			2300000	Pyrene	150 J			
			2300000	Fluoranthrene	110 J			
	10	11/9/99	62	Benzo(a)pyrene	180 J	220	Aroclor 1260	21 J
			620	Benzo(b)fluoranthene	290 J			
			62000	Chrysene	220 J			
			none	Phenanthrene	200 J			
			2300000	Pyrene	370 J			
			620	Benzo(a)anthracene	140 J			
			none	Benzo(g,h,i)perylene	82 J			
	21	11/9/99	2300000	Fluoranthrene	300 J	220	Aroclor 1260	18 J
	26	11/9/99	620	Indeno(1,2,3-cd)pyrene	82 J	220	Aroclor 1260	14 J
MW06	15	1/25/00	35,000	Bis(2-ethylhexyl) phthalate	78 J			
		duplicate						

Table 4-6 (continued)
Summary of Soil Analytical Results—Detected SVOCs and PCBs, NMCRC-LA, 1999-2000

Well No. Direct Push	Sample Depth feet bgs	Sample Date	SVOCs		PCBs		
			Screening Level (a)	Analyte	ug/kg	Qualifier	Screening Level (a) Analyte ug/kg Qualifier
DP01	10	11/3/99	none	2-Methylnaphthalene	672		
			56,000	Naphthalene	1300		
	15	11/3/99	none	2-Methylnaphthalene	3100		
			56,000	Naphthalene	7300		
	20	11/3/99	none	2-Methylnaphthalene	1400		
			56,000	Naphthalene	3100		
		duplicate	none	2-Methylnaphthalene	340	J	
			56,000	Naphthalene	460	J	
	25	11/3/99	none	2-Methylnaphthalene	854		
			56,000	Naphthalene	1700		
DP02	25	11/2/99	none	2-Methylnaphthalene	330	J	
			56,000	Naphthalene	580	J	
DP08	18	1/25/00	35,000	Bis(2-ethylhexyl) phthalate	190	J	
DP10	10	1/26/00	35,000	Bis(2-ethylhexyl) phthalate	2500		
DP11	5	1/26/00	35,000	Bis(2-ethylhexyl) phthalate	670		
	16	1/26/00	35,000	Bis(2-ethylhexyl) phthalate	110	J	

Notes:

(a) Source of Screening Criteria: United States Environmental Protection Agency Region IX Residential Preliminary Remediation Goals (PRGs), dated 01 October 1999

1. Analytes not listed above were not detected.
2. No SVOCs or PCBs were detected in any soil samples at sampling locations MW07, DP03 and DP09.
3. **BOLD** values are results exceeding screening levels

bgs = below ground surface
 DP = Direct Push
 J = estimated concentration
 MW = Monitoring Well
 ug/kg = micrograms per kilogram
 NMCRC-LA = Naval and Marine Corps Reserve Center Los Angeles.
 PCBs = Polychlorinated Biphenyls
 SVOCs = Semi-Volatile Organic Compounds

Table 4-7
Summary of Soil Analytical Results—Fate and Transport Parameters, NMCRC-LA, 1999-2000

Boring No.	Sample Depth	Sample Date	pH units	Heterotrophic Plate Count CFU/10g	Anumoma mg/kg	Total Kjeldahl Nitrogen mg/kg	Bromide mg/kg	Chloride mg/kg	Fluoride mg/kg	Nitrate mg/kg	Nitrites mg/kg	Total Phosphate/Ortho-phosphate mg/kg	Sulfates mg/kg	Total Sulfide mg/kg	Moisture %	Total Organic Carbon mg/kg
MW01	10	11/05/99	6.70	ND	ND	624	NA	NA	NA	8.7	0.060 J	404/NA	2230	ND	11.4	1600
	20	11/05/99	7.60	ND	ND	200	NA	NA	NA	11.0	0.260 J	723/NA	38	ND	13.1	13100
MW05	21	11/05/99	7.30	740	ND	318	NA	NA	NA	15.0 J	ND	814/NA	522	3 J	17.6	ND
MW06	10	01/25/00	8.70	130,000	0.5	630	ND	12	9.0	263	0.032 J	456/ND	130	1 J	12.8	ND
	20	01/25/00	8.30	6500	0.4	847	ND	87	3.6	6.0	0.047 J	959/ND	250	1 J	5.5	ND
MW07	25	01/24/00	7.73	240,000 J	87.8	650	ND	252	5.1	3.0 J	ND	788/ND	44	0.9 J	15.9	ND
DP01	5	11/03/99	8.96	4 J	ND	300	NA	NA	NA	5.2	0.050 J	194/NA	62	ND	12.7	1200
	10	11/03/99	8.67	9 J	ND	240	NA	NA	NA	6.3	ND	511/NA	45	ND	13.8	360
	15	11/03/99	8.70	5 J	ND	150	NA	NA	NA	6.5	0.061 J	2100/NA	41	ND	14.2	510
	20	11/03/99	8.70	1 J	ND	283	NA	NA	NA	6.0	0.150 J	627/NA	140	ND	14.6	234J
dupl	20	11/03/99	8.70	2 J	ND	365	NA	NA	NA	6.0 J	0.032 J	496/NA	120	ND	16.2	870J
	25	11/03/99	8.48	840 J	ND	220	NA	NA	NA	6.0	0.027 J	856/NA	63	ND	14.5	940

Notes:

- CFU = Colony Forming Unit
- DP = Direct Push boring
- dup = duplicate sample
- g = grams
- J = Estimated Concentration
- mg/kg = milligram per kilogram
- MW = monitoring well
- NA = Not Analyzed
- ND = Not detected at or above reporting limits
- NMCRC-LA = Naval and Marine Corps Reserve Center-Los Angeles
- No. = number
- UJ = Undetected at an estimated concentration

Table 4-8
Summary Statistics for Groundwater Sample Results, NMCRC-LA, 1999-2000

Analytical Parameter	No. of Samples ^(a)	No. of Detections	Maximum Concentration	Sample ID	Screening Criteria	Criteria Source	No. of Detections above Criteria
TPH-Diesel (mg/L)	17	11	2.4	99RC-GG01-W-1-26.7	NE		none
TPH-Gasoline (mg/L)	17	12	13	99RC-GG01-W-1-26.7	NE		none
TPH-Motor Oil (mg/L)	17	6	0.2J	00RC-MW02-W-1-28	NE		none
VOCs ^(b) (µg/L)							
1,2,4-Trimethylbenzene	17	7	1130	99RC-GG01-W-1-26.7	12	PRG	3
1,2-Dichloroethane	17	11	27	00RC-MW01-1-27	5	MCL	11
1,3,5-Trimethylbenzene	17	5	320	99RC-GG01-W-1-26.7	12	PRG	1
Benzene	17	6	588	99RC-GG01-W-1-26.7	1.0	MCL	6
Chloroform	17	6	10	99RC-MW04B-W-1-30	0.16	PRG	6
Carbon Disulfide	17	1	1	00RC-MW06-W-1-22	1000	PRG	none
Ethylbenzene	17	4	711	99RC-GG01-W-1-26.7	700	MCL	1
Isopropylbenzene	17	8	54	99RC-GG01-W-1-26.7	NE		
Naphthalene	17	5	120	99RC-GG01-W-1-26.7	6.2	PRG	2
N-Propylbenzene	17	5	304	99RC-GG01-W-1-26.7	61	PRG	1
P-Isopropyltoluene	17	3	10	99RC-GG01-W-1-26.7	NE		
Sec-Butylbenzene	17	5	12	99RC-GG01-W-1-26.7	61	PRG	none
Tert-Butylbenzene	17	5	1J	00RC-GG11-W-1-29	61	PRG	none
Tetrachloroethene	17	3	2J	99RC-GG02-W-1-26.7	5.0	MCL	none
Toluene	17	2	313	99RC-GG01-W-1-26.7	150	MCL	1
m/p Xylene	17	2	1590	99RC-GG01-W-1-26.7	1750	MCL	none
o-Xylene	17	1	528	99RC-GG01-W-1-26.7	1750	MCL	none

Table 4-8 (continued)
Summary Statistics for Groundwater Sample Results, NMCRC-LA, 1999-2000

Analytical Parameter	No. of Samples ^(a)	No. of Detections	Maximum Concentration	Sample ID	Screening Criteria	Criteria Source	No. of Detections above Criteria
SVOCs^(b) (µg/L)							
2-Methylnaphthalene	14	4	26	99RC-GG02-W-1-26.7	NE		none
Naphthalene	14	3	76	99RC-GG02-W-1-26.7	6.2	PRG	none
Di-N-Butyl Phthalate	14	1	19	00RC-GG09-W-1-25	NE		none
PCBs (µg/L)	14	0	--	--	0.5	MCL	none
Metals^{(c) (d)} (µg/L)							
Aluminum	16	2	131	00RC-MW07-WF-1-23	1000	MCL	0
Antimony	16	3	11.3	00RC-MW07-WF-1-23	6	MCL	1
Arsenic	16	3	11.2	99RC-GG03-WF-1-26.7	50	MCL	0
Barium	16	16	445	99RC-GG02-WF-1-26.7	1000	MCL	0
Beryllium	16	0	--	--	4	MCL	0
Cadmium	16	1	0.35	00RC-MW07-WF-1-23	5	MCL	0
Chromium	16	7	4.3	99RC-GG03-WF-1-26.7	50	MCL	0
Cobalt	16	6	16.5	99RC-GG03-WF-1-26.7	2200	PRG	0
Copper	16	13	12.1	00RC-MW07-WF-1-23	1300	MCL	0
Iron	16	9	784	99RC-GG02-WF-1-26.7	300	SMCL	1
Lead	16	2	16.8	99RC-GG01-WF-1-26.7	15	MCL	1
Mercury	16	12	0.56	00RC-MW05-WF-1-22	2	MCL	0
Molybdenum	16	15	344	00RC-MW06-WF-1-22	180	PRG	1
Nickel	16	10	41.2	99RC-GG03-WF-1-26.7	100	MCL	0

Table 4-8 (continued)
Summary Statistics for Groundwater Sample Results, NMCRC-LA, 1999-2000

Analytical Parameter	No. of Samples ^(a)	No. of Detections	Maximum Concentration	Sample ID	Screening Criteria	Criteria Source	No. of Detections above Criteria
Selenium	16	5	22.6	99RC-GG02-WF-1-26.7	50	MCL	0
Silver	16	1	3.4	00RC-MW02-WF-1-28	100	SMCL	0
Thallium	16	0	--	--	2	MCL	0
Vanadium	16	2	4.4	00RC-MW07-WF-1-23	260	PRG	0
Zinc	16	15	24.9	99RC-GG01-WF-1-26.7	5000	SMCL	0
Organic Lead (µg/L)	17	0	--	--	0.0036	PRG	none

Notes:

- (a) Field Quality Control duplicate samples are not included in the table.
- (b) If not listed in this table, the remaining analytes were not detected.
- (c) Samples were analyzed for metals on both an unfiltered and filtered basis.
- (d) Groundwater samples were analyzed both filtered and unfiltered, but only unfiltered results are presented here because they represent concentrations dissolved in groundwater, not groundwater plus entrained soil particles. The groundwater grab sample from sampling location GG08 was not included due to relatively high turbidity even after filtering.
- (e) At background levels as discussed in Section 4.3 and Appendix J.

Screening levels are from the U.S. Environmental Protection Agency Region IX Preliminary Remediation Goals, October 1, 1999 for tap water.

- J = Estimated Concentration
- MCL = Screening levels are State Primary Maximum Contaminant Levels (MCL).
- mg/L = Milligrams Per Liter
- µg/L = Micrograms Per Liter
- NE = Screening level not established
- NMCRC-LA = Naval and Marine Corps Reserve Center-Los Angeles
- No. = Number
- PCBs = Polychlorinated Biphenyls
- PRG = Preliminary Remediation Goals
- SMCL = Secondary MCL
- SVOCs = Semivolatile Organic Compounds
- TPH = Total Petroleum Hydrocarbons
- VOCs = Volatile Organic Compounds

Table 4-9
Summary of Groundwater Analytical Results—TPH, NMCRC-LA, 1999-2000

Well No.	Sample Date	TPH Gasoline mg/L	TPH Diesel mg/L	TPH Motor Oil mg/L
		Screening Level		
		NE	NE	NE
MW01	16-Nov-99	0.20	0.07 J	ND
	31-Jan-00	ND	0.2 J (a)	0.06 J
dupl.	31-Jan-00	ND	0.2 J (a)	0.04 J
MW02	16-Nov-99	0.53	0.1 J	ND
dupl.	16-Nov-99	0.61	0.1 J	ND
	1-Feb-00	0.09	0.2 J	0.2 J
MW03	16-Nov-99	ND	ND	ND
MW4B	16-Nov-99	ND	ND	ND
MW05	15-Nov-99	ND	ND	ND
	31-Jan-00	ND	0.03 J	ND
MW06	1-Feb-00	0.02 J	ND	0.05 J
MW07	1-Feb-00	0.17	ND	ND
Groundwater Grab Samples				
GG01	3-Nov-99	13.00	2.4 (b)	ND
GG02	2-Nov-99	3.18	1.4 (a)	ND
GG03	2-Nov-99	2.48	0.6 (a)	ND
GG08	26-Jan-00	0.05	0.2 J	0.06 J
GG09	25-Jan-00	0.13	ND	ND
GG10	27-Jan-00	0.20	0.2 J	0.03 J
GG11	27-Jan-00	1.10	0.6 (a)	0.05 J

Notes:

dupl. = duplicate sample
 GG = groundwater grab sample
 J = estimated concentration
 mg/L = milligrams per liter
 MW = monitoring well
 ND = not detected at or above reporting limit listed
 NE = screening level not established
 NMCRC-LA = Naval and Marine Corps Reserve Center-Los Angeles
 TPH = total petroleum hydrocarbons

Other laboratory qualifiers:

- (a) mixture in jet fuel/mineral spirit range
- (b) mixture in gasoline/mineral spirit range

Table 4-10
Summary of Groundwater Analytical Results—Detected VOCs, NMCRC-LA, 1999-2000

Well No.	Sample Date	Benzene ug/L	Toluene ug/L	Ethylbenzene ug/L	Xylenes ug/L	MTBE ug/L	Trimethylbenzenes ug/L	1,2-DCA ug/L	Other VOCs Detected (ug/L)
		1.0 MCL	150 MCL	700 MCL	1,750 MCL	13 MCL	12 PRG	0.5 MCL	
MW01	16-Nov-99	7.0	ND	2.0 J	6.0	ND	39.0	22.0	Isopropylbenzene 1.0 J
	31-Jan-00	16.0	ND	ND	ND	ND	17.0	27.0	Naphthalene 2.0 J sec-Butylbenzene 0.9 J Isopropylbenzene 3.0 J Naphthalene 2.0 J
dupl.	31-Jan-00	13.0	ND	ND	ND	ND	15.0	28.0	sec-Butylbenzene 0.6 J Isopropylbenzene 2.0 J Naphthalene 2.0 J
MW02	16-Nov-99	ND	ND	ND	ND	ND	ND	3.0 J	Chloroform 1.0 J
dupl.	16-Nov-99	6.0 J	0.5 J	2.0 J	3.0 J	ND	31.0 J	3.0 J	sec-Butylbenzene 1.0 J Chloroform 1.0 J Isopropylbenzene 2.0 J p-Isopropyltoluene 1.0 J sec-Butylbenzene 1.0 J tert-Butylbenzene 0.5 J Chloroform 0.7 J Isopropylbenzene 0.7 J
	1-Feb-00	7.0	ND	ND	ND	ND	0.5 J	18.0	

Table 4-10 (continued)
Summary of Groundwater Analytical Results—Detected VOCs, NMCRC-LA, 1999-2000

Well No.	Sample Date	Benzene ug/L	Toluene ug/L	Ethylbenzene ug/L	Xylenes ug/L	MTBE ug/L	Trimethylbenzenes ug/L	1,2-DCA ug/L	Other VOCs Detected (ug/L)
Screening Level									
		1.0 MCL	150 MCL	700 MCL	1,750 MCL	13 MCL	12 PRG	0.5 MCL	
MW03	16-Nov-99	ND	ND	ND	ND	ND	ND	ND	Chloroform
MW4B	16-Nov-99	ND	ND	ND	ND	ND	ND	ND	Chloroform
MW05	15-Nov-99	ND	ND	ND	ND	ND	ND	3.0 J	none
	31-Jan-00	ND	ND	ND	0.5 J	ND	ND	ND	none
MW06	1-Feb-00	ND	ND	0.5 J	0.6 J	ND	ND	ND	Carbon Disulfide
MW07	1-Feb-00	ND	ND	ND	ND	ND	8.0 J	8.0	Isopropylbenzene
GG01	3-Nov-99	588	313	711	2,118	ND	1,450	ND	sec-Butylbenzene
									Isopropylbenzene
									p-Isopropyltoluene
									Naphthalene
GG02	2-Nov-99	15.0	ND	ND	ND	ND	ND	4.0 J	tert-Butylbenzene
									p-Isopropyltoluene
									Naphthalene
GG03	2-Nov-99	ND	ND	4.0 J	ND	ND	5.0 J	2.0 J	Isopropylbenzene
									n-Propylbenzene
GG08	25-Jan-00	ND	0.5 J	ND	ND	ND	ND	1.0 J	tert-Butylbenzene
GG09	26-Jan-00	ND	ND	0.6 J	ND	ND	ND	6.0	sec-Butylbenzene
									Isopropylbenzene
									n-Propylbenzene
									Tetrachloroethene
GG10	27-Jan-00	ND	ND	ND	ND	ND	ND	ND	tert-Butylbenzene
									Chloroform

Table 4-10 (continued)
Summary of Groundwater Analytical Results—Detected VOCs, NMCRC-LA, 1999-2000

Well No.	Sample Date	Benzene	Toluene	Ethylbenzene	Xylenes	MTBE	Trimethylbenzenes	1,2-DCA	Other VOCs Detected
		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	(ug/L)
		Screening Level							
		1.0 MCL	150 MCL	700 MCL	1,750 MCL	13 MCL	12 PRG	0.5 MCL	
GG11	27-Jan-00	1.0 J	ND	7.0	ND	ND	5.0 J	3.0 J	sec-Butylbenzene tert-Butylbenzene Chloroform Isopropylbenzene p-Isopropyltoluene Naphthalene n-Propylbenzene
									0.7 J 1.0 J 0.6 J 5.0 2.0 J 25.0 16.0

Notes:

- = dichloroethane
- = duplicate sample
- = groundwater grab sample
- = estimated concentration
- = Screening levels are California Primary Maximum Contaminant Levels.
- = methyl-tert-butyl ether
- = monitoring well
- = micrograms per liter
- = not detected at or above reporting limit listed
- = Naval and Marine Corps Reserve Center-Los Angeles
- = number
- = USEPA tap water Preliminary Remediation Goals are used as screening levels for trimethylbenzenes (total 12 ug/L), naphthalene (6.2 ug/L), n-propylbenzene (61 ug/L), sec-butylbenzene (61 ug/L), chloroform (0.16 ug/L), and tertbutylbenzene (61 ug/L).
- = volatile organic compound

A screening level for p-isopropyltoluene had not been established.

The MCL for tetrachloroethene is 5.0 ug/L.

BOLD values are results exceeding screening levels

Table 4-11
Summary of Groundwater Analytical Results—Detected SVOCs and PCBs, NMCRC-LA,
1999-2000

Well No.	Sample Date	Results of SVOC Analyses		Results of PCB Analyses
		Compounds Detected	Concentration $\mu\text{g/L}$	Compounds Detected $\mu\text{g/L}$
MW01	11/16/99	none		none
	01/31/00	none		none
dupl.	01/31/00	none		none
MW02	11/16/99	none		none
dupl.	11/16/99	none		none
	02/01/00	none		none
MW05	01/31/00	none		none
MW06	02/01/00	none		none
MW07	02/01/00	none		none
Groundwater Grab (GG) Samples				
GG01	11/03/99	2-Methylnaphthalene	17	none
		Naphthalene	64	
GG02	11/02/99	2-Methylnaphthalene	26	none
		Naphthalene	76	
GG03	11/02/99	2-Methylnaphthalene	5 J	none
GG08	01/26/00	none		none
GG09	01/25/00	Di-n-Butyl Phthalate	19	none
GG10	01/27/00	none		none
GG11	01/27/00	2-Methylnaphthalene	12	none
		Naphthalene	19	

Notes:

dupl. = duplicate sample
 GG = groundwater grab
 J = estimated concentration
 ug/L = micrograms per liter
 MW = monitoring well
 No. = number
 NMCRC-LA = Naval and Marine Corps Reserve Center-Los Angeles
 PCB = polychlorinated biphenyl
 SVOC = semivolatile organic compound

Naphthalene is also detectable by VOCs Method 8260; see Table 4-8 and 4-10 for those results

BOLD values are results exceeding screening levels

USEPA tap water Preliminary Remediation Goals (PRGs) are used as a screening level for naphthalene (6.2 ug/L)

2-Methylnaphthalene and di-n-butyl phthalate have no established screening level.

Table 4-12
Summary of Groundwater Analytical Results—Dissolved Metals, NMCRC-LA, 1999-2000

Well No.	Sample Date	Screening Level																	
		Aluminum	Antimony	Arsenic	Barium	Chromium	Cobalt	Copper	Iron	Lead	Mercury	Molybdenum	Nickel	Selenium	Thallium	Vanadium	Zinc		
		MCL 1,000	MCL 6.0	MCL 50	MCL 1,000	MCL 50	PRG 2,200	PRG 1,400	PRG 11,000	AL 15	MCL 2.0	PRG 180	MCL 100	MCL 50	MCL 2.0	PRG 260	PRG 11,000		
Upgradient Wells																			
MW03	16-Nov-99	ND	ND	ND	77.7	ND	ND	ND	ND	ND	0.22 J	63.5	ND	ND	ND	ND	9.6 J		
MW4B	16-Nov-99	ND	ND	ND	17.4	ND	ND	5.8 J	ND	ND	0.20 J	37.1	ND	ND	ND	ND	12.8 J		
UST/Source Area Wells and Piezometers																			
MW01	16-Nov-99	ND	ND	ND	23.4	ND	ND	6.5 J	ND	ND	0.21 J	52.7	6.1	ND	ND	ND	14.6 J		
dupl.	31-Jan-00	ND	ND	ND	26.1 J	3.1 J	ND	5.7 J	11.0 J	ND	0.36 J	66.4 J	9.7	ND	ND	ND	23.6 J		
MW02	16-Nov-99	1,960 J	ND	ND	41.3 J	7.4 J	ND	10.7 J	3,050 J	ND	0.49 J	16.6 J	8.7	ND	ND	ND	18.4 J		
dupl.	16-Nov-99	ND	ND	ND	34.1	ND	ND	10.9 J	ND	ND	0.16 J	36.3	8.1	ND	ND	ND	22.3 J		
	1-Feb-00	ND	ND	ND	33.8	ND	ND	7.9 J	ND	ND	0.19 J	36.3	6.6	ND	ND	ND	12.4 J		
GG01	3-Nov-99	ND	ND	ND	32.8	1.3	0.9 J	6.3	32.1 J	ND	0.47 J	35.4	7.6	ND	ND	3.7	10.0		
GG02	2-Nov-99	ND	ND	ND	433	2.8 J	12.6	7.6 J	38.1 J	16.8	0.48 J	60.7	26.8	13.6	ND	ND	24.9		
GG03	2-Nov-99	ND	ND	ND	445	2.8 J	7.9	6.4 J	784	ND	ND	30.6	14.7	22.6	ND	ND	9.1 J		
GG08	26-Jan-00	4,180	ND	ND	219	4.3 J	16.5	6.6 J	163	ND	ND	41.0	41.2	18.3	ND	ND	12.1 J		
GG09	25-Jan-00	47 J	2.6	ND	156	8.3	30.3	ND	4,430	3.8	0.20 J	32.7	23.4	ND	ND	29.7	24.1		
GG10	27-Jan-00	ND	ND	ND	80.4	ND	7.5	9.8	23.2	ND	0.28 J	24.0	7.8	16.6	ND	ND	7.2		
GG11	27-Jan-00	ND	ND	ND	43.4	ND	ND	ND	144 J	ND	ND	46.7	ND	ND	ND	ND	17.4		
Downgradient Wells																			
MW05	15-Nov-99	ND	ND	ND	18.3	ND	ND	8.4 J	ND	ND	0.38 J	19.6	ND	ND	ND	ND	17.4 J		
	31-Jan-00	ND	5.3 J	ND	20.8	4.3 J	1.3 J	9.1 J	ND	ND	0.56	ND	ND	ND	ND	ND	7.8		
MW06	1-Feb-00	ND	2.8	5.2	14.6	1.7	1.9 J	6.8	ND	ND	0.38 J	344	3.4 J	ND	ND	ND	9.6		
MW07	1-Feb-00	131 J	11.3	9.4	25.7	1.9	ND	12.1	207 J	6.9	0.29	17.3	9.6	ND	ND	4.4	11.1		

Notes:

MW = monitoring well
 dupl. = duplicate sample
 J = estimated concentration
 NMCRC-LA = Naval and Marine Corps Reserve Center-Los Angeles
 GG = groundwater grab sample
 U = not detected at or above reporting limit

All concentrations are in micrograms per liter (ug/L) from filtered samples
 Beryllium, cadmium, and silver were also analyzed for and were either not detected or were detected at estimated concentrations below the reporting limit.
 Screening levels are California Primary Maximum Contaminant Levels (MCLs), Action Level (AL), or USEPA tap water Preliminary Remediation Goals (PRGs).
BOLD values are results exceeding screening levels

Table 4-13
Summary of Groundwater Analytical Results—General Chemistry, NMCRC-LA, 1999-2000

Well No.	Sample Date	pH	TDS mg/L	Chloride mg/L	Ammonia mg/L	Alkalinity mg/L	Calcium mg/L	Magnesium mg/L	Potassium mg/L	Sodium mg/L	Orthophosphate mg/L	Fluoride mg/L	Bromide mg/L
MW01	16-Nov-99	7.09	2,310	230	0.04 J	442	201	109	14.3	234	0.1 R	ND	ND
dupl.	31-Jan-00	6.74	1,680	239	0.07	454	205	111	8.34	225	ND	ND	ND
MW02	31-Jan-00	6.71	1,710	234	0.06	591	336	231	13.1	233	ND	ND	ND
dupl.	16-Nov-99	6.90	1,570	189	0.03 J	390	162	72.7	11.8	203	0.1 R	ND	ND
	16-Nov-99	6.95	1,520	181	0.03 J	426	163	73.3	11.8	198	0.1 R	ND	ND
	1-Feb-00	7.06	1,440	215	0.05 J	412	174	84.8	11.2	207	ND	ND	ND
MW03	16-Nov-99	7.29	962	85.9	0.03 J	390	114	46.2	4.87	133	0.1 R	ND	ND
MW4B	16-Nov-99	7.22	--	--	--	--	100	36.7	7.01	122	--	--	--
MW05	15-Nov-99	6.95	--	--	--	--	327	217	16.0	238	--	--	--
	31-Jan-00	6.90	2,660	571	0.06	517	341	236	12.5	236	ND	ND	ND
MW06	1-Feb-00	6.93	2,430	790	0.04 J	317	265	188	18.7	251	ND	ND	ND
MW07	1-Feb-00	6.71	2,690	726	0.04 J	470	348	229	19.7	259	ND	ND	ND
Groundwater Grab (GG) Samples													
GG01	3-Nov-99	7.01	1,540	205	ND	364	205	105	9.7	212	ND	ND	ND
GG02	2-Nov-99	7.05	2,570	439	ND	441	268	158	14.0	210	ND	ND	ND
GG03	2-Nov-99	6.76	2,240	516	ND	429	313	199	13.9	226	ND	ND	ND
GG08	26-Jan-00	6.90	--	--	--	--	186	72.9	6.57	140	--	--	--
GG09	25-Jan-00	6.67	2,730	701	0.08	406	371	241	15.2	265	ND	ND	ND
GG10	27-Jan-00	7.08	--	--	--	--	163	71.4	6.43	166	--	--	--
GG11	27-Jan-00	7.01	--	--	--	--	155	67.7	5.81	162	--	--	--

Notes:

- dupl. = duplicate sample
- mg/L = milligrams per liter
- NMCRC-LA = Naval and Marine Corps Reserve Center-Los Angeles
- MW = monitoring well
- R = result rejected after validation,
- TDS = total dissolved solids
- U = not detected at or above reporting limit listed
- = denotes not parameter not analyzed

Results for calcium, magnesium, potassium, and sodium from analyses of filtered samples

Table 4-14
Summary of Groundwater Analytical Results—Fate and Transport Parameters, NMCRC-LA, 1999-2000

Well No.	Sample Date	Redox millivolts	Sulfate mg/L	Sulfide mg/L	Iron II mg/L	Total Kjeldahl Nitrogen mg/L	Nitrate as N mg/L	Dissolved Oxygen mg/L	Carbon Dioxide mg/L	Methane mg/L	Ethane mg/L	Ethene mg/L
MW01	16-Nov-99	78.0	479	ND	negative	4.23	11.7	ND ^(a)	598 J	ND	--	--
dupl.	31-Jan-00	443.0	602	ND	negative	8.49 J	12.5	2.4 J	160	ND	ND	ND
	31-Jan-00	--	598	ND	--	4.59 J	13.5	3.9 J	150	ND	ND	ND
MW02	16-Nov-99	114.3	312	0.07 J	negative	2 J	9.77	ND ^(a)	593 J	ND	--	--
dupl.	16-Nov-99	--	323	0.07 J	--	0.88 J	9.90	ND ^(a)	120 J	ND	--	--
	1-Feb-99	447.0	518	ND	negative	6.52 J	13.2	1.3 J	130	ND	ND	ND
MW03	16-Nov-99	104.9	169	0.08 J	negative	0.30	2.81	ND ^(a)	57 J	ND	--	--
MW05	31-Jan-00	454.0	880	ND	negative	4.52 J	33.2	2.9 J	224	ND	ND	ND
MW06	1-Feb-00	429.0	619	ND	negative	8.07 J	ND	3.1 J	42	ND	ND	ND
MW07	1-Feb-00	446.0	765	ND	negative	11.9 J	31.7	3.5 J	190	ND	ND	ND
Groundwater Grab (GG) Samples												
GG01	3-Nov-99	--	540	ND	--	4.40	11.5	5.1 J	120 J	ND	--	--
GG02	2-Nov-99	--	522	0.07 J	--	1.80	25.6	2.7 J	671 J	ND	--	--
GG03	2-Nov-99	--	621	ND	--	4.66	32.5	2.7 J	120 J	ND	--	--
GG08	25-Jan-00	--	--	--	--	--	--	--	--	--	--	--
GG09	26-Jan-00	--	905	ND	--	59.20	42.5	3.1 J	170	9 J	ND	ND
GG10	27-Jan-00	--	--	--	--	--	--	--	--	--	--	--
GG11	27-Jan-00	--	--	--	--	--	--	--	--	--	--	--

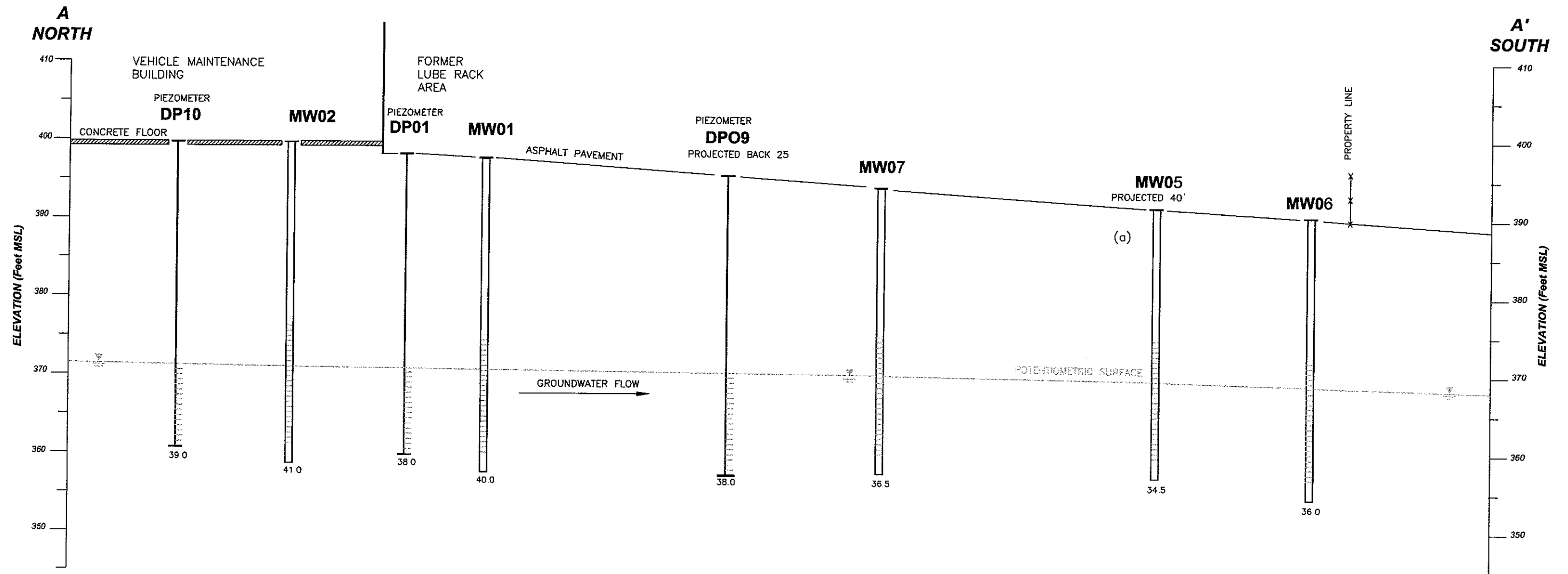
Notes:

dupl. = duplicate sample
 J = estimated concentration
 mg/L = milligrams per liter
 MW = monitoring well
 ND = Not detected

NMCRC-LA = Naval and Marine Corps Reserve Center-Los Angeles
 -- = denotes parameter not analyzed

Oxidation-reduction potential (redox) and iron II values were measured during groundwater sampling with field meter and colorimetric test kit, respectively.

(a) Data validators qualified dissolved oxygen results as ND because a laboratory method blank sample contained dissolved oxygen. The original reported results were 7.4 mg/L for MW01, 8.6 mg/L for MW02, 9.1 mg/L for MW02 duplicate, and 10.6 mg/L for MW03.



HORIZONTAL SCALE (FT.)

10 0 30

VERTICAL SCALE (FT.)

5 0 15

2X VERTICAL EXAGGERATION

GROUND SURFACE

SCREENED PORTION OF GROUNDWATER MONITORING WELL

TOTAL DEPTH OF WELL (FEET BELOW GROUND SURFACE)

40.0

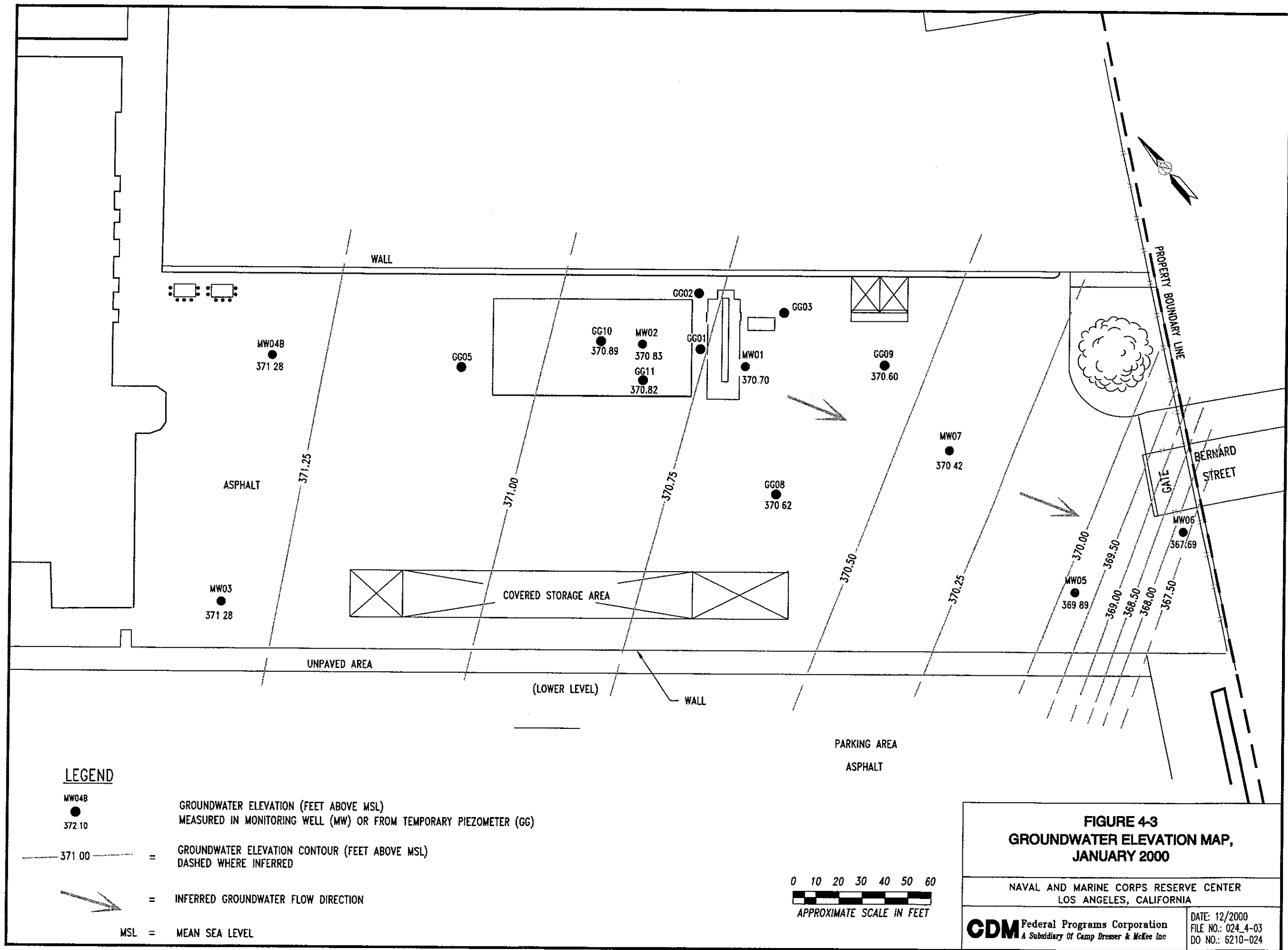
WATER LEVEL 1/27/2000

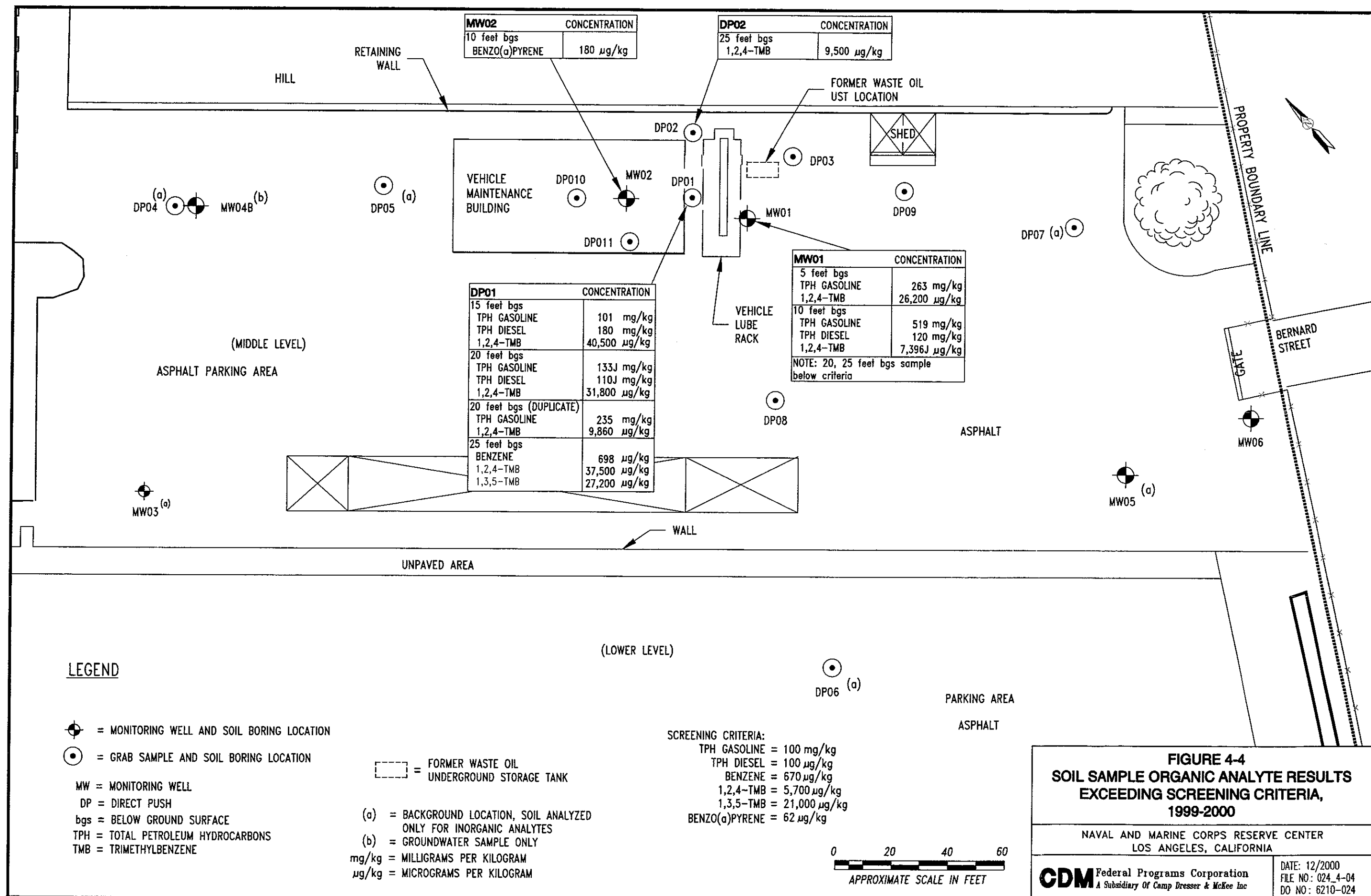
FIGURE 4-2
HYDROGEOLOGIC SECTION A-A'

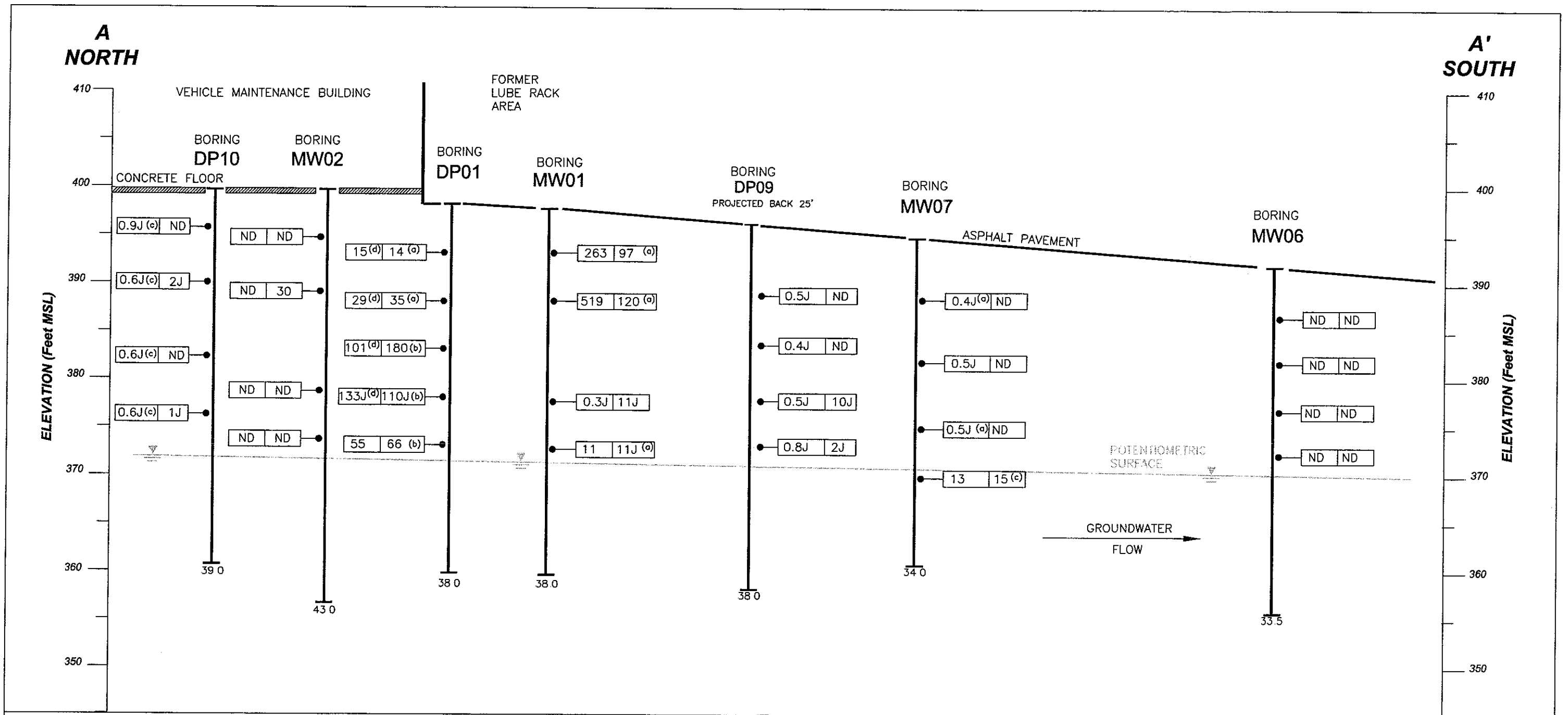
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DATE: 12/2000
FILE NO: 024_4-02
DO NO: 6210-024







SOIL SAMPLE ANALYTICAL RESULTS

TOTAL PETROLEUM HYDROCARBONS,
GASOLINE (TPHg) AND DIESEL (TPHd)

• TPHg TPHd

CONCENTRATIONS IN MILLIGRAMS PER KILOGRAM (MG/KG)
J = ESTIMATED CONCENTRATION
ND = NOT DETECTED

(a) = MIXTURE IN JET FUEL/KEROSENE RANGE
(b) = MIXTURE IN GASOLINE/MINERAL SPIRITS RANGE
(c) = NOT GASOLINE PATTERN, RATHER UNKNOWN
PEAKS IN C₉ TO C₁₁ RANGE
(d) = NOT A TYPICAL GAS PATTERN, PEAKS ARE AT HEAVIER
PORTION OF CHAIN

HORIZONTAL SCALE (FEET)
10 0 30

VERTICAL SCALE (FEET)
5 0 15
2X VERTICAL EXAGGERATION

SOIL BORING

GROUND SURFACE

WATER LEVEL
11/15/99

SOIL SAMPLE
SUBMITTED FOR ANALYSIS

TOTAL DEPTH OF BORING
(FT BELOW GROUND SURFACE)

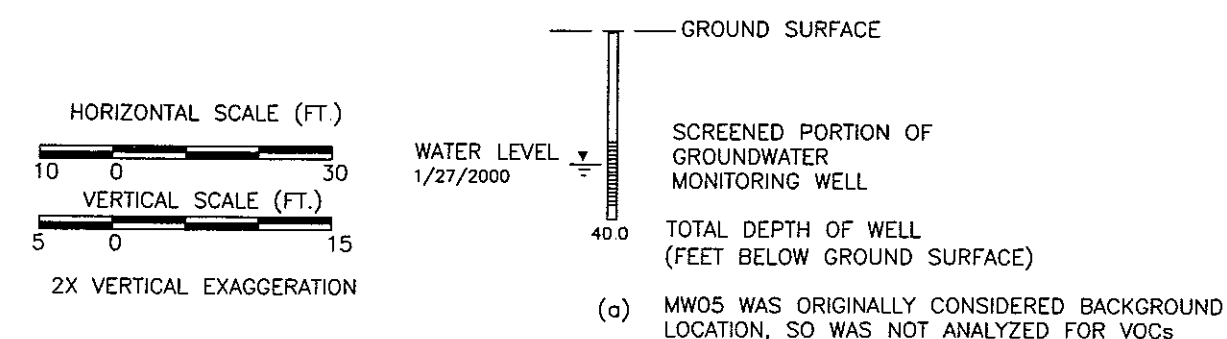
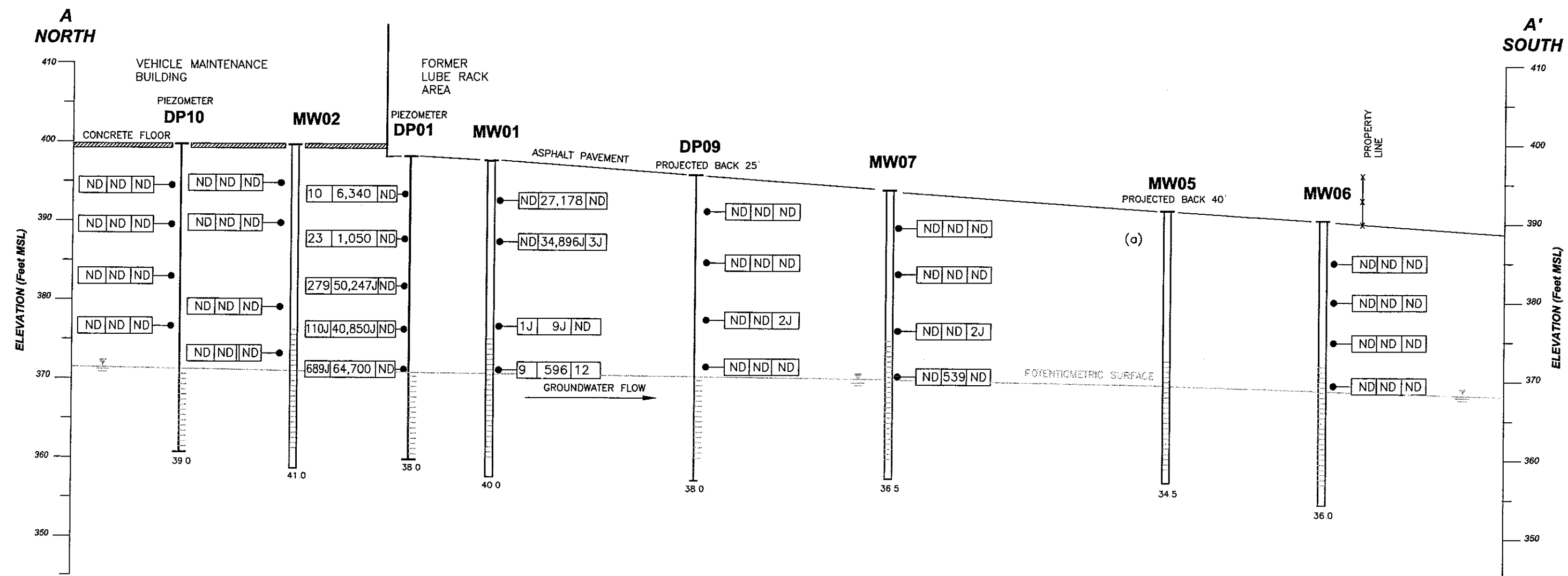
50

FIGURE 4-5
SOIL TPH RESULTS
SECTION A-A',
1999 - 2000

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SOIL SAMPLE ANALYTICAL RESULTS

• BZ TMB DCA

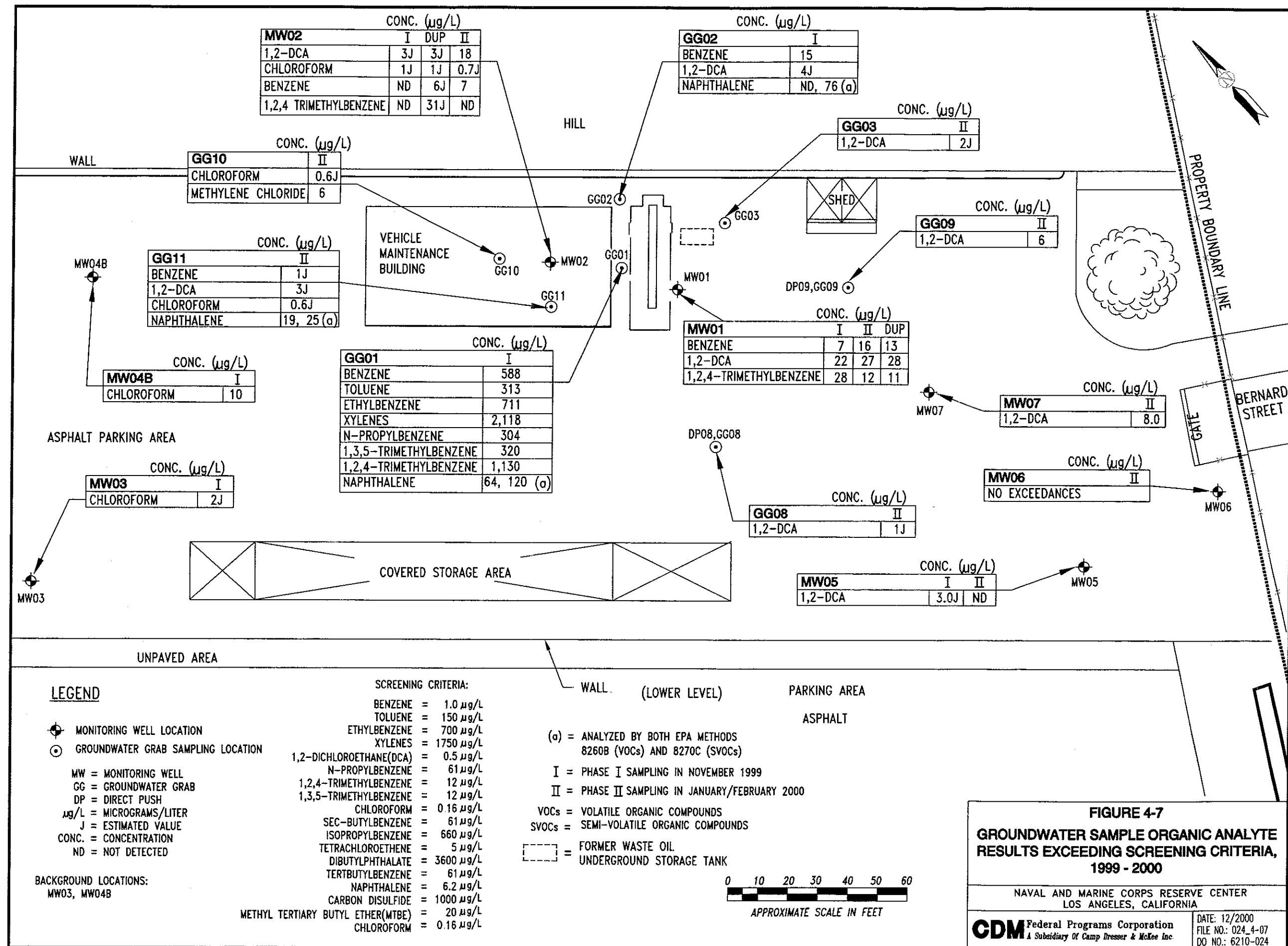
CONCENTRATIONS IN MILLIGRAMS PER KILOGRAM (MG/KG)
 J = ESTIMATED CONCENTRATION
 ND = NOT DETECTED
 BZ = BENZENE
 TMB = 1,2,4 TRIMETHYLBENZENE + 1,3,5-TRIMETHYLBENZENE
 DCA = 1,2 DICHLOROETHANE

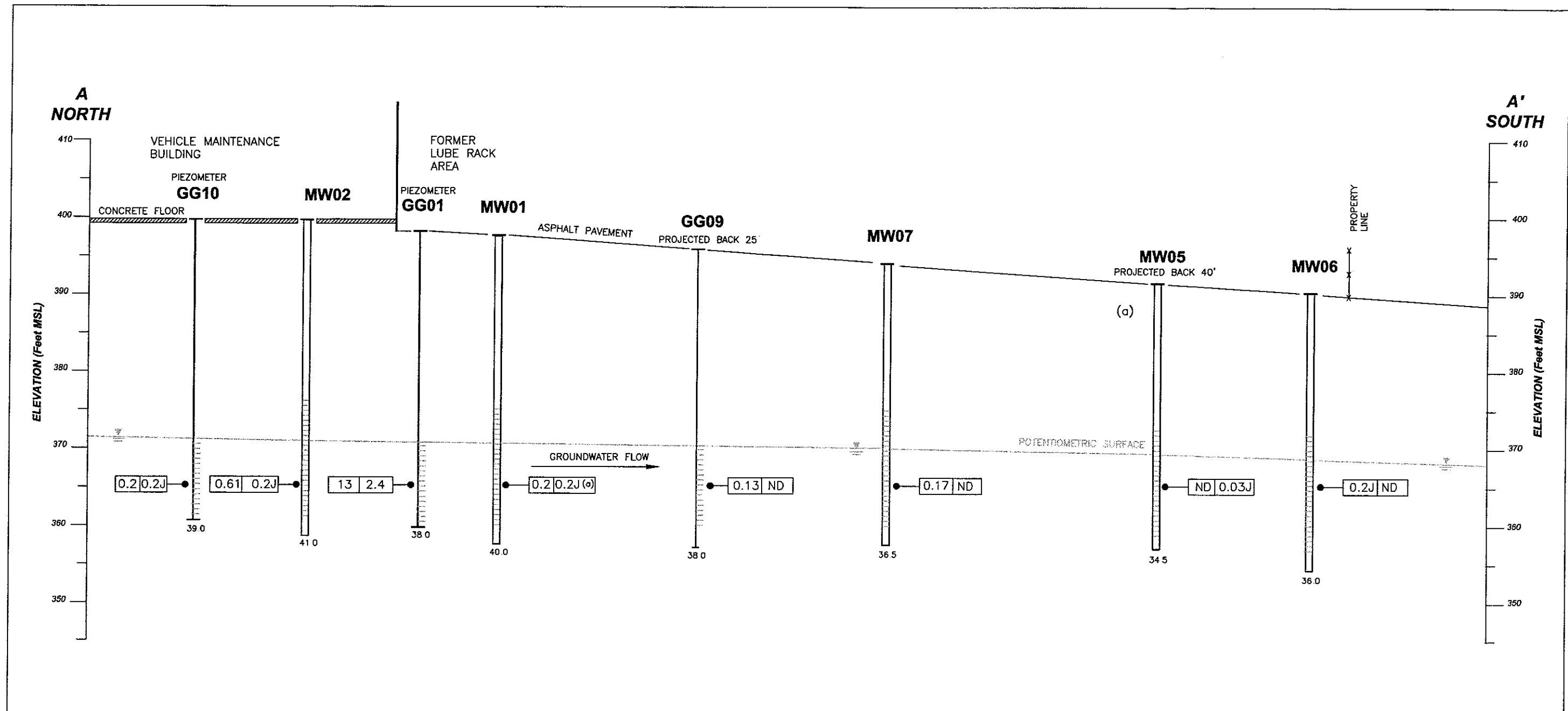
FIGURE 4-6
SELECTED VOCs RESULTS IN SOIL, SECTION A-A'
1999 - 2000

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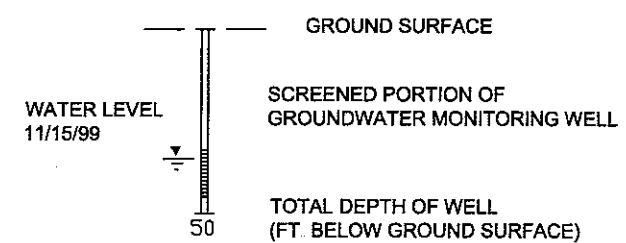
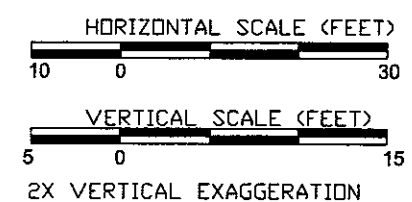
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GROUNDWATER SAMPLE ANALYTICAL RESULTS



TOTAL PETROLEUM HYDROCARBONS,
GASOLINE (TPHg) AND DIESEL (TPHd)

• TPHg TPHd

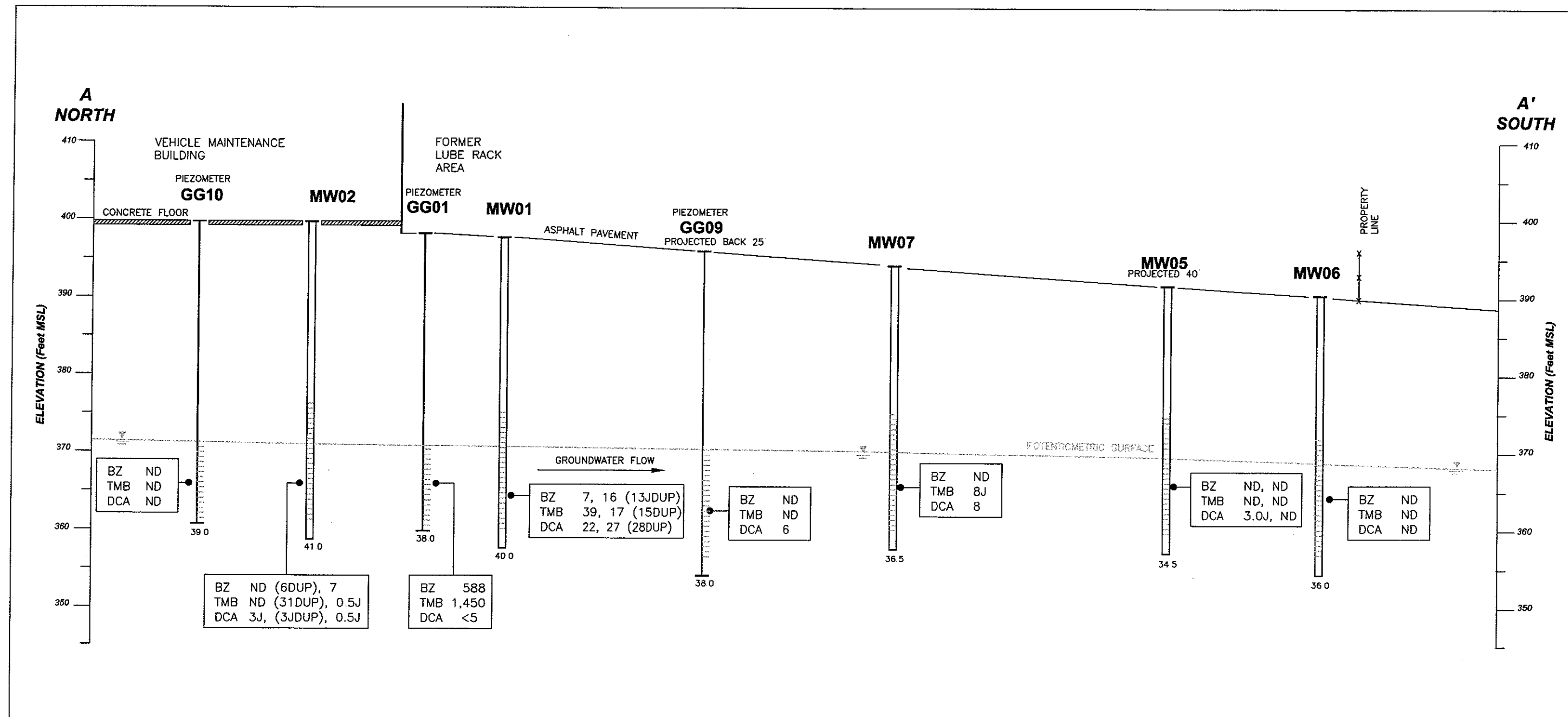
CONCENTRATIONS IN MILLIGRAMS PER LITER (MG/L)
 J = ESTIMATED CONCENTRATION
 ND = NOT DETECTED
 (a) = MIXTURE IN JET FUEL/KEROSENE RANGE

FIGURE 4-8
GROUNDWATER TPH RESULTS
SECTION A-A',
1999 - 2000

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 DO NO: 6210-024



GROUNDWATER SAMPLE ANALYTICAL RESULTS

MAXIMUM CONCENTRATIONS OF SELECTED VOCs:
 BENZENE (BZ)
 TOTAL TRIMETHYLBENZENES (TMB): 1,2,4-TMB AND 1,3,5-TMB
 1,2-DICHLOROETHANE (DCA)
 CONCENTRATIONS IN (µg/L)

REGULATORY DRINKING WATER STANDARDS:
 BENZENE 1.0 µg/L
 TOTAL TRIMETHYLBENZENES 120 µg/L TAP WATER PRG
 1,2-DICHLOROETHANE 0.5 µg/L

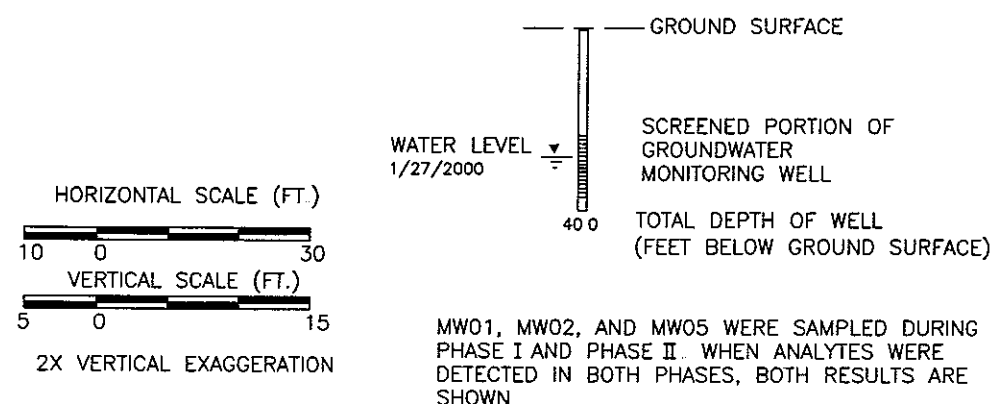
DUP = DUPLICATE SAMPLE
 ND = NOT DETECTED
 J = ESTIMATED CONCENTRATIONS

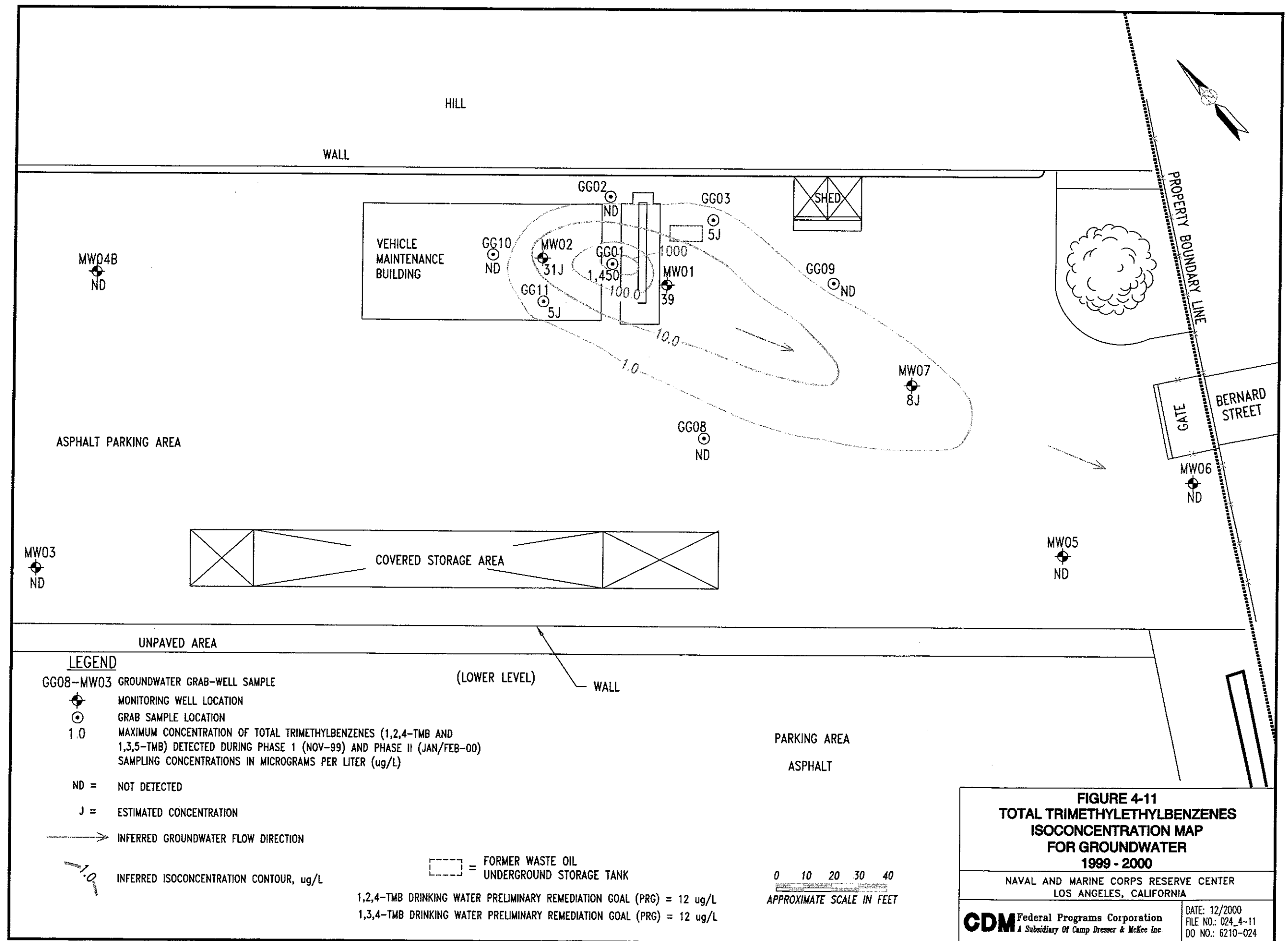
FIGURE 4-9
SELECTED VOCs RESULTS IN GROUNDWATER,
SECTION A-A'
1999 - 2000

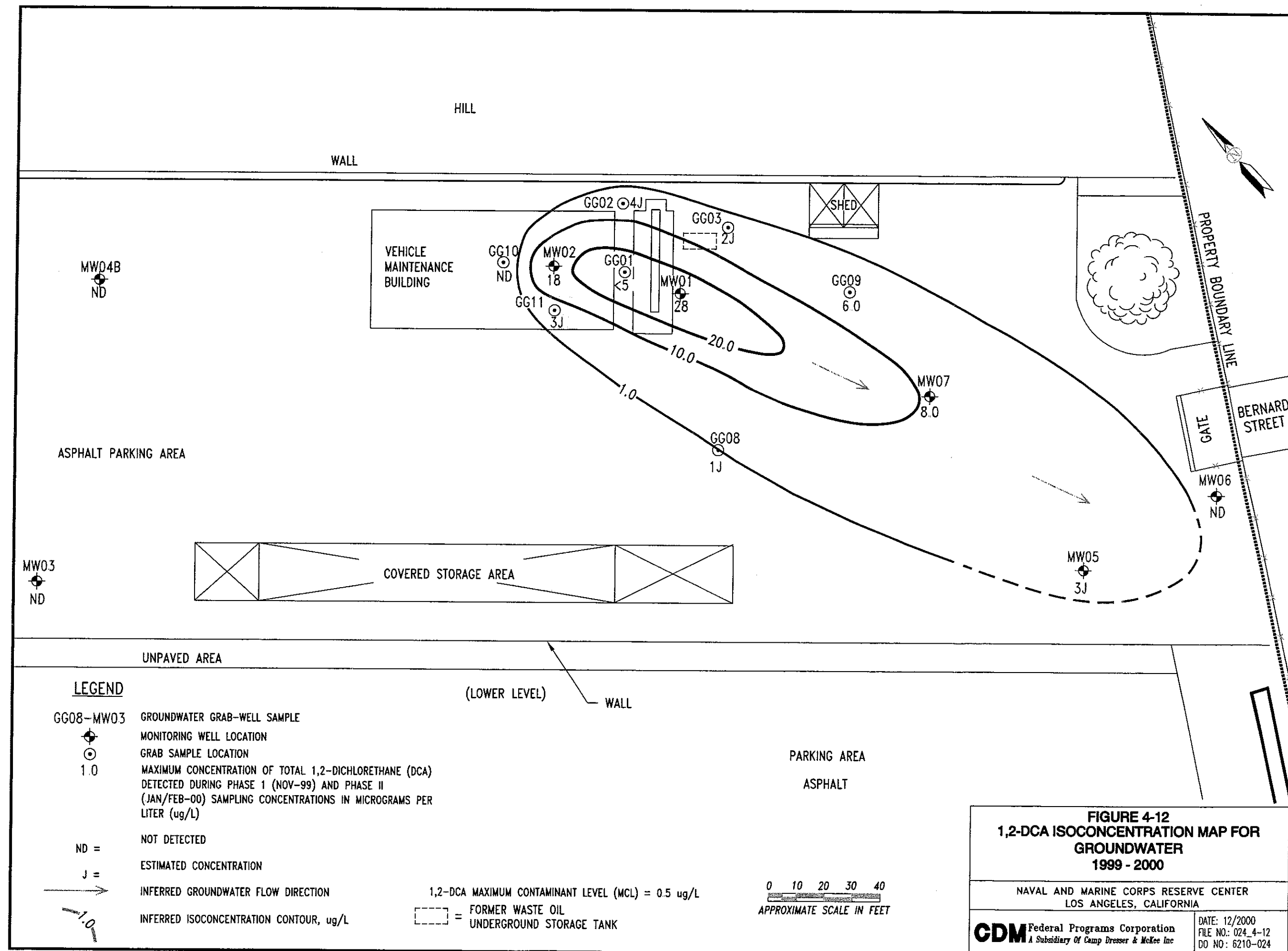
NAVAL AND MARINE CORPS RESERVE CENTER
 LOS ANGELES, CALIFORNIA

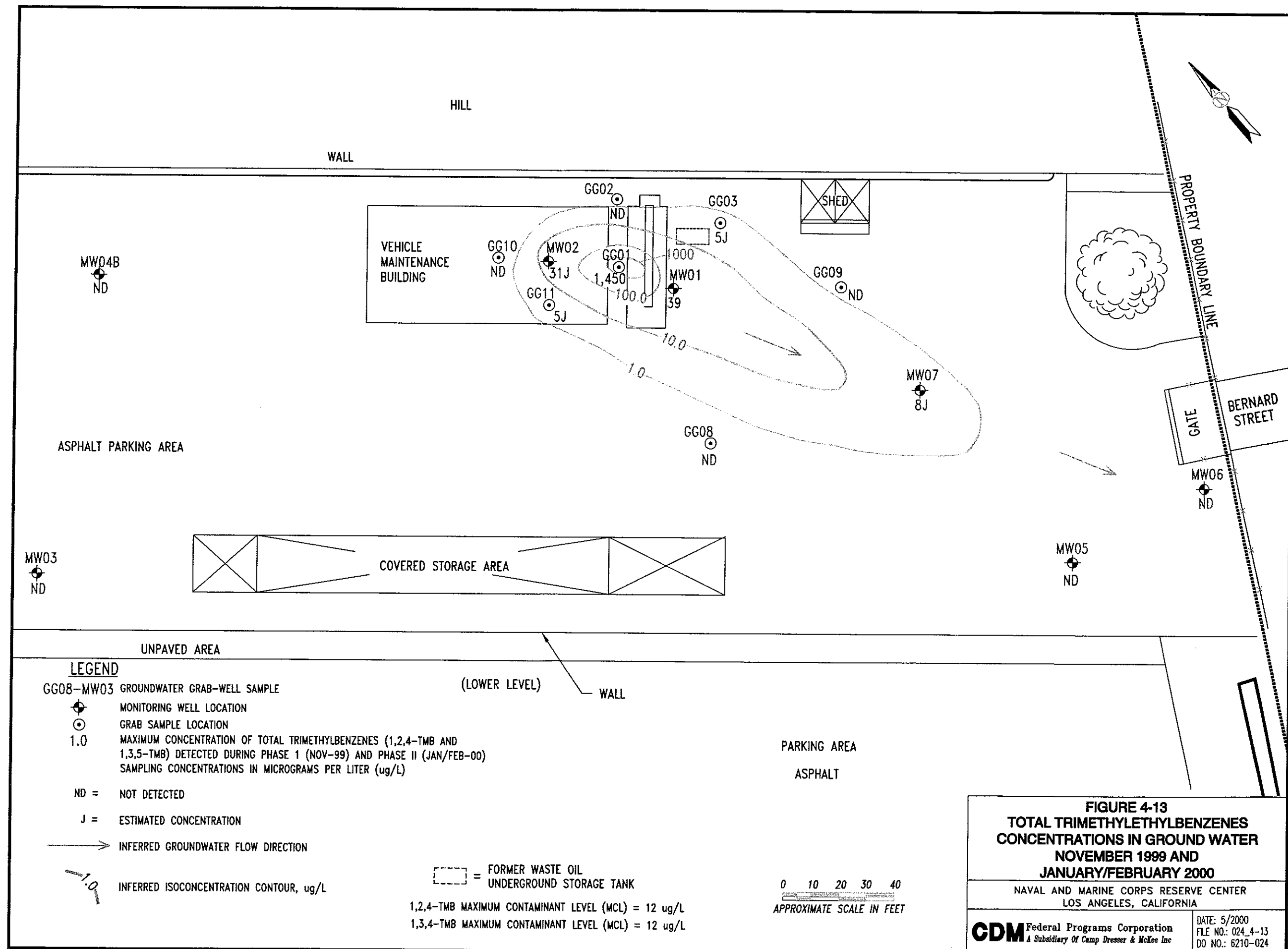
CDM Federal Programs Corporation
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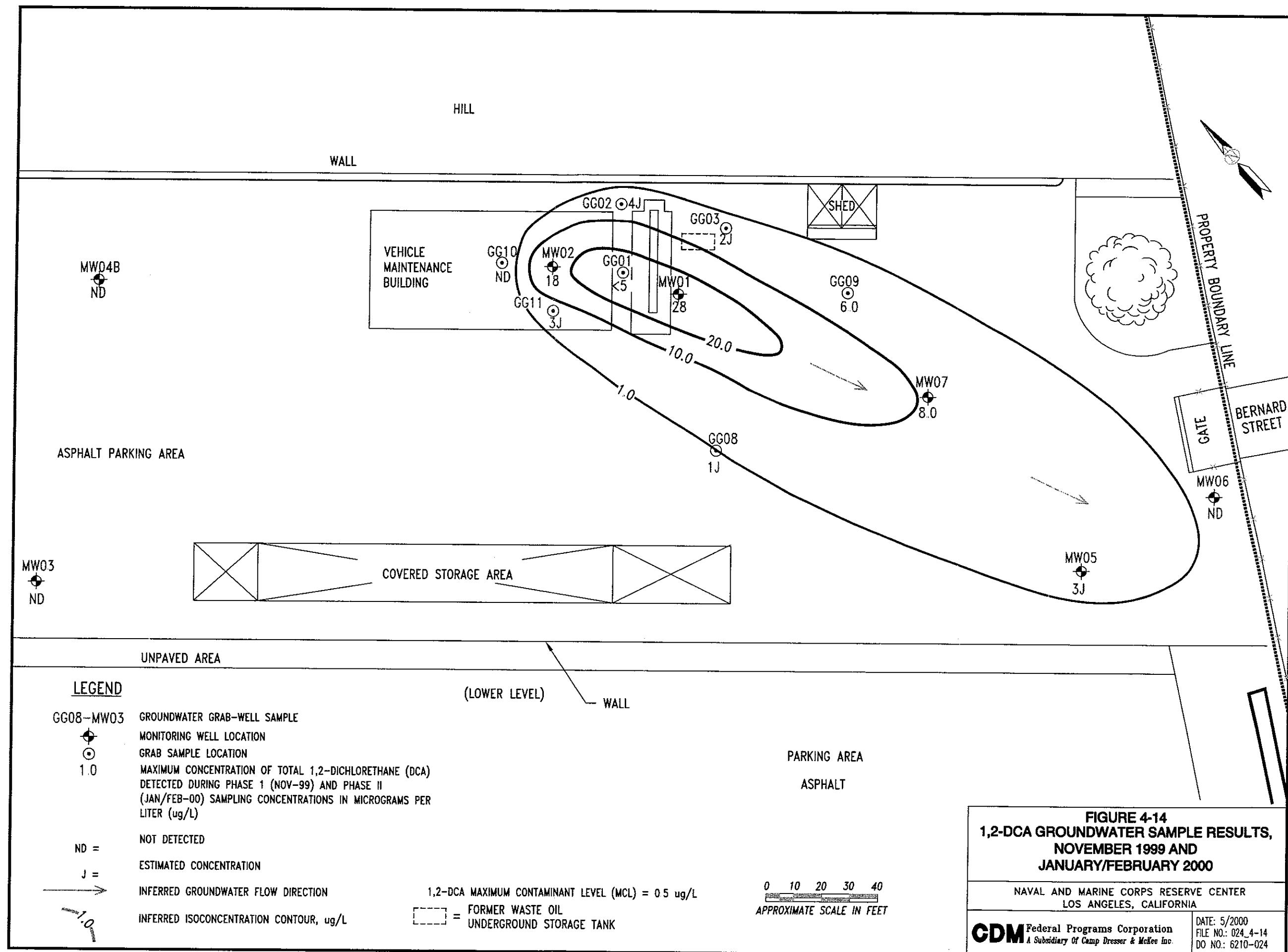
DATE: 12/2000
 FILE NO: 024_4-09
 DO NO: 6210-024











5.0 QUALITY ASSURANCE/QUALITY CONTROL

The soil and groundwater sampling and analysis activities were performed according to the guidance and QA/QC procedures described in the regulatory-approved Work Plan for Site Inspection at Installation Restoration Site 1, NMCRC-LA (CDM Federal 1999). The Work Plan contained the FSP in Appendix A and the QAPP in Appendix B. SOPs presented in Appendix E of the Work Plan were also followed. Laboratory analyses were performed according to approved analytical methods, as well as QA/QC requirements described in the QAPP.

This section summarizes the performance of field procedures compared to the Work Plan, FSP, and QAPP (Section 5.1), summarizes the results of field QC samples, summarizes data validation findings, and presents an overall assessment of data quality.

5.1 FIELD PROCEDURES

Field methods and procedures described in Section A.7.0 of the FSP (CDM Federal 1999) were followed during both Phase I (1 to 16 November 1999) and Phase II (24 January to 1 February 2000).

Two phases were performed instead of three because enough data were collected during Phase I to combine the planned Phases II and III. This was possible in part because sampling location MW05, originally selected as a background location, was actually a directly downgradient location. CDM Federal also analyzed the groundwater from this well for TPH and VOCs, even though not required by the FSP. This allowed information about the extent of potential contamination to be assessed during Phase I instead of Phases II or III.

As approved by DTSC in Work Plan Addendum Number 1 (CDM Federal 2000), Phase II consisted of installing 2 wells and collecting soil samples from these borings, as well as performing 4 additional borings and collecting 4 groundwater grab samples. The total number

of wells installed was 8 (instead of 10 originally planned), but the number of groundwater grab samples was 7 (instead of 3 as originally planned), resulting in two more groundwater sampling locations than planned. In addition, CDM Federal resampled groundwater from wells MW01, MW02, and MW05 during Phase II at DTSC's request even though not originally scoped. This allowed for a more complete data set to be obtained.

As described in Section 3.4.2, since a direct push probe could not be used to reach groundwater and collect a groundwater grab sample, a 2-inch diameter PVC temporary piezometer with slotted well casing was installed in each groundwater grab sampling location using HSA drilling and sampled the next day. This allowed water level measurements to be made, leading to additional data points to prepare a more accurate water level potentiometric map (see Section 4.2).

Direct push sampling was originally planned at 7 locations during Phase I; however, direct push drilling was not successful at this site, as described in Section 3.2.1. Either drilling rig limitations and/or soil type prevented the rig to push deeper than 17 feet bgs at the first boring (DP03). HSA drilling was used to perform the remaining borings.

As described in Section 3.4.1, the boring for the background monitoring well planned for installation on the north side of the administration building encountered refusal at 19 feet bgs, so the background well was installed immediately adjacent to DP04 and labeled well MW04B.

Geotechnical analyses for six samples were collected using a thin-walled Shelby Tube sampler, while four samples were collected using the standard penetration split-spoon sampler because the drilling contractor did not provide a sufficient number of Shelby Tubes. The four geotechnical samples collected using the split-spoon sampler were pushed rather than hammered to provide undisturbed samples; therefore, data quality is not considered to have been compromised.

During well development and well purging, several of the wells were purged dry. SOPs in the approved Work Plan for this project do not require additional well development or purging after a well goes dry. However, field crews allowed recharge to occur and proceeded with additional development or purging as much as possible to allow more representative samples to be collected.

Groundwater grab samples were relatively turbid compared to samples collected from wells. This is logical because well development and filter packs are designed to remove more sediments than a temporary piezometer with slotted well casing can remove. Groundwater grab sample contaminant results may be biased high if soil particles entrained in the groundwater contained contaminants.

Iron (II) field test kits were delivered by the supplier one week late. The test kits arrived onsite on 4 November 1999, after the first three groundwater grab samples (GG01, GG02, and GG03) had been collected. Jars containing groundwater from these sampling locations were kept onsite and analyzed on 4 November 1999, but these test kits should be used within minutes after sample collection, not one or two days later. Therefore, iron (II) field test kit results for these three samples (all negative for iron [II]) should be considered highly suspect, as indicated in footnote (a) of Table 3-6. For the subsequent groundwater samples, field test kits were used immediately after sampling (all results were negative for iron [II]).

Manganese was not analyzed in the laboratory as planned for background assessment purposes because of a laboratory error (they analyzed for magnesium instead of manganese). This omission is not considered to have affected results of the background assessment because aluminum and iron data, collected only for background assessment purposes, were sufficient to adequately assess background conditions as discussed in Appendix J.

The lube rack, removed in October 1999 to allow sampling to proceed, was not reassembled due to safety concerns about properly reconstructing a rack that was intended to support heavy

vehicles. The Los Angeles City Fire Department Chief agreed that the scrap metal could be left onsite.

5.2 RESULTS OF FIELD QC SAMPLES

Field QC samples consisted of trip blanks, field blanks, equipment rinsates, and field duplicates as described in the QAPP (CDM Federal 1999). Field QC samples were collected at the required specified frequency. Field QC sample results are summarized in Appendix I (see Table I-1).

Trip Blanks. In summary, one or more of the eleven trip blanks contained methylene chloride, toluene, ethylbenzene, xylenes, and 1,2-DCA in certain samples no higher than 9 $\mu\text{g/L}$; the first two are recognized as common laboratory contaminants (EPA 1994a). Data validators qualified associated site sample results following EPA data validation guidelines.

Field Blanks. One or both of the field blank samples collected was reported to contain certain VOCs (xylenes, ethylbenzene, and MTBE up to 3 $\mu\text{g/L}$), phthalates (also common laboratory contaminants [EPA 1994a]), TPH up to 0.1 mg/L, five metals up to 30 $\mu\text{g/L}$, and ammonia at 70 $\mu\text{g/L}$. Because the field blank consisted of deionized ASTM-type water purchased from a supplier and was pre-certified as clean, it is not likely that it actually contained all of these contaminants. Rather, it is possible that these results may represent laboratory cross-contamination. Site sample results, especially for water samples, that were reported at similar concentrations should be used with caution.

Equipment Rinsates. One or more of the five equipment rinsate results indicated the presence of VOCs (1,2,4-TMB, 1,3,5-TMB, toluene, MTBE, methylene chloride, n-propylbenzene, isopropylbenzene, and 4-methyl 2-pentanone up to 4 $\mu\text{g/L}$, as well as ethylbenzene and xylenes up to 43 $\mu\text{g/L}$), phthalates, TPH, eight metals, and ammonia as indicated in Appendix I.

As discussed in Appendix O, a combination of field blank and equipment rinsate results were strong enough evidence to qualify phthalates and MTBE in certain associated samples as non-detect (U/UJ), whereas TPH, metals, and VOCs results were not qualified as non-detect but concentrations at similar levels should be used with caution.

Field QC Duplicates. Field QC duplicate samples showed varying consistency. Because of soil heterogeneity, reproducibility in duplicate soil samples is more difficult to achieve. Groundwater sample duplicate sample results generally showed good consistency. One exception was the duplicate sample for well MW01 for certain metals (e.g., aluminum and iron).

5.3 SUMMARY OF DATA VALIDATION FINDINGS

Appendix O contains data validation reports and Form I laboratory reports on which data validators added data qualifications (U = undetected, J = estimated concentration, N = presumptive evidence of the presence of that analyte, R = rejected [i.e., unusable] data point). At the beginning of Appendix O, a data validation summary has been provided.

Overall, very few sample results were rejected. Excluding rejected data points for one sample analyzed for SVOCs by the SPLP leaching method to assess fate and transport, only 10 of over 14,000 (0.07%) non-field QC sample and non-leachate data points were rejected. These included three phosphorus results, two acetone results, two 2-butanone results, and three 4-nitrophenol results.

Only one data point was qualified "N." This was a result of 20 mg/L organic lead reported in the groundwater sample from well MW07 about 100 feet downgradient of the lube rack/former gasoline UST area. No other soil or groundwater samples had organic lead detected. The data validators noted a significant difference between duplicate injections, resulting in the reported concentration of 20 mg/L as "highly suspect." In addition, this reported result of 20 mg/L (i.e., 20,000 µg/L) organic lead exceeds the total lead concentration of 11.8 µg/L in the same

sample (almost 1700 times higher), which is theoretically impossible. Therefore, it is recommended that this result not be considered a true detection.

5.4 DATA QUALITY ASSESSMENT

This section presents the results of the internal evaluation of both field and laboratory QC checks. Data quality was assessed against the established data quality objectives (DQOs) in the FSP and QAPP (CDM Federal 1999). The evaluation of the validated data set involved comparing the objectives versus the actual data results through the use of the precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters (QAPP Section B.1.3.2.2).

Overall, the data quality for samples collected for this project is considered acceptable.

5.4.1 Precision

Precision (i.e., reproducibility of results) was primarily identified during data validation activities as discussed in Appendix O. Laboratory duplicate and field duplicate sample results were used to assess precision and appropriately qualify data. In general, most laboratory duplicate results were within control limits. Heterogeneity in soil field duplicate samples resulted in lower precision than groundwater samples, although all results were considered useable.

Duplicate groundwater sample results for one sample (collected at location MW01 on 31 January 2000) did not correlate closely with the original sample from this well for aluminum and iron (almost two orders of magnitude higher). No explanation could be found, although all other metals correlated more closely and no significant impacts to data quality are considered to have occurred.

5.4.2 Accuracy

Accuracy (i.e., how close a result is to the actual concentration) was primarily assessed by data validation activities discussed in Appendix O. Surrogates were used to assess accuracy and qualify data appropriately. Most surrogate recoveries were within control limits.

Groundwater grab sample results may be biased high compared to well sample results, as discussed in Section 5.1.

Dissolved oxygen (DO) results measured in the field are considered more accurate than results reported by the laboratory because DO measurements must be made as soon as possible. However, DO results greater than the approximate saturation point of oxygen in water (9 mg/L) suggest that field DO measurements may have been affected by aeration during well purging.

5.4.3 Representativeness

Representativeness is the reliability with which a measurement or measurement system reflects the true conditions under investigation (EPA 1989). Representativeness is influenced by the number and location of the sampling points, sampling timing and frequency of monitoring efforts, and the field and laboratory sampling procedures (EPA 1989). The representativeness of data was enhanced by the use of established field and laboratory procedures and their consistent application.

Representativeness was assessed quantitatively by evaluating laboratory method blank and field blank (trip blanks, equipment rinse blanks, and source water field blanks) results to qualify data appropriately. Certain laboratory and method blanks contained a small number of analytes, so associated site sample results were appropriately qualified as not detected "U"; see Appendix O). Field QC results indicate detections (see Appendix I) that suggest caution in assessing site sample results at similar concentrations (see Appendix O). It should be noted

that concentration of contaminants in the lube rack/former gasoline UST area far exceeded field QC sample concentrations; therefore, field QC sample detections did not have an impact on site conclusions or recommendations.

The high degree of turbidity in the groundwater grab sample from location GG08 suggest that results should be used with caution. Three filters were used to filter out sediments from the groundwater during sample collection activities, but the sample was still relatively turbid after using three filters. Results may be biased high because sediment was still entrained in the groundwater sample and reported concentrations may include not only contaminants in groundwater, but also in part contaminants in soil. Other groundwater grab samples may have been impacted to a lesser degree.

5.4.4 Completeness

The completeness of the data is described as a ratio of the amount of data expected from the field program versus the amount of valid data actually received. Valid data are considered to be those data that have not been rejected (were not R-qualified either from data validation or internal data review). Completeness can be expressed by the following equation:

$$C = \frac{(\text{number of valid results}) \times 100}{\text{total number of requested results}}$$

The completeness goal of 90% useable data was exceeded for this project (99.93%).

One other way to assess completeness is to identify whether each decision to be made (Step 2 of the DQO process identified in Section A.6.0 of the FSP) was accomplished. This analysis is summarized below:

- *Has the gasoline UST been removed?* The geophysical survey did not find any evidence of the UST still in place in the subsurface, even at the location with highest soil and groundwater contamination, so it appears that the UST has been removed.

- *Is groundwater located within 50 feet bgs?* Yes. The SI identified that the water table was located approximately 25 to 30 feet bgs at the site at the time of the investigation.
- *Is the extent of contamination delineated in Phase I?* No; therefore, Phase II was performed.
- *Is the extent of contamination delineated in Phase II?* Yes, the extent of contamination was very well assessed; therefore, Phase III was not required (although the total number of site samples was not decreased).
- *Are background metal levels above site sample results?* No results were extremely high above apparent background levels, but some may have been slightly elevated, so these were included in the HHRA.
- *Do sample results exceed screening criteria?* Yes, a small number of analyte concentrations exceeded screening criteria (residential PRGs for soil and MCLs or PRGs for groundwater); therefore, a fate and transport assessment and HHRA were performed.
- *Is the 1,2-DCA contamination associated with a petroleum-based hydrocarbon product?* There is strong evidence that 1,2-DCA was associated with gasoline, rather than solvents, at this site.
- *Is site closure possible without remedial action and/or further groundwater monitoring because the human health risk presented by soil and groundwater is in the generally acceptable range as defined by the National Contingency Plan (NCP)?* See Sections 7, 8, and 9.

5.4.5 Comparability

Comparability evaluates whether the reported data is comparable with similar data reported by other organizations. The comparability of the laboratory results was found to be acceptable. All samples were analyzed by the same laboratory, using the list of published methods specified in the FSP. All units were consistent and appropriate for the matrix sampled.

It should be noted that results reported for TPH do not necessarily mean that gasoline, diesel, or motor oil, respectively, were detected, but that petroleum hydrocarbons in ranges similar to these petroleum products were detected. Degradation of the petroleum products over time (e.g., weathering) can affect results. As indicated in Table 4-9 footnotes provided by

laboratory chemists, some of the results do not appear to be typical fresh gasoline or diesel fuel.

Data collected in 1999-2000 correlate very well with data collected in 1996, both with respect to the analytes detected and the location of contamination

The groundwater isoconcentration maps (Figures 4-10 to 4-12) show similar patterns, with the more recalcitrant analyte (1,2-DCA) showing a larger area of impact than the analyte that is more degradable (benzene), as would be expected.

6.0 CONTAMINANT FATE AND TRANSPORT

This section evaluates factors that control the fate and transport of site contaminants in the groundwater aquifer and in the vadose zone (soil). The factors that are addressed include chemical mobility, potential contaminant pathways, soil physical properties and soil characteristics, modeling results, and natural attenuation (biodegradation) potential. These factors were used to assess the potential for continued leaching of contaminants from the soil to groundwater, as well as the reactive transport of these constituents in groundwater. Models were utilized to assess potential recharge quantities, as well as transport within the vadose zone and in the upper aquifer.

6.1 CHEMICAL MOBILITY

Chemicals of potential concern at the site are primarily fuel-related organic compounds and the fuel additive 1,2-DCA. The properties of chemicals that are of most interest in evaluating the fate and transport include those parameters that control their ability to sorb on the aquifer matrix. These parameters include the organic carbon partitioning coefficient (K_{oc}) and water solubility. Calculated parameters derived from these values and soil characteristics include the soil/water partitioning coefficient and retardation factor. The initial risk assessment analysis identified five indicator compounds that are present at the site, pose a potential risk, and represent different classes of analytes that have different mobilities within aquifer systems. These compounds are benzene, 1,3,5-TMB, naphthalene, 1,2-DCA and lead. Table 6-1 summarizes these parameters for the indicator chemicals of potential concern.

The rate of movement of chemicals with groundwater is related to the degree of sorption, which is expressed as a soil/water partitioning coefficient (K_d). The partitioning coefficient is the ratio of soil concentration to the concentration of water in contact with this soil under equilibrium conditions. Standard EPA reference documents were used to identify these partitioning coefficients for the organic compounds. This ratio for lead was calculated using results of leachate testing on site soils. For organic compounds, the organic carbon

partitioning coefficient (K_{oc}) was used in combination with observed total organic carbon concentrations in the soil to estimate K_d .

The retardation factor describes the ratio of the velocity of groundwater to that of the contaminant and is calculated from the partitioning coefficient. For example, a retardation factor (R) of 1 would mean that the contaminant front moves at the same velocity as the groundwater, while a retardation factor of 2 would indicate that the contaminant front moves at one half the velocity of groundwater.

6.2 POTENTIAL CONTAMINANT PATHWAYS

Contaminated media at the site include vadose zone soils and the aquifer materials. Recharge is currently limited in the area of release due to the presence of pavement. Future conditions could conceivably result in removal of the pavement and establishment of native grass cover in the area. Recharge quantities could then increase, which would result in increased transport of contaminants in the vadose zone to groundwater. Contaminants in the vadose zone will be subject to processes such as biodegradation, sorption to the soil matrix, and volatilization. Percolating recharge with dissolved contamination may then discharge to the groundwater and mix with the groundwater flowing under the site. Contaminants within the aquifer are also affected by sorption and biodegradation processes. Transport through these pathways is quantitatively evaluated in subsequent sections.

6.3 SOIL PHYSICAL PROPERTIES

Physical properties relevant to assessment of transport pathways were summarized previously in Table 3-2. These analyses show that the subsurface at the site is dominated by fine grain lithologies. The majority of the samples have greater than 50 percent fines present, which has the effect of lowering permeability and increasing sorption potential. This is confirmed by the remolded laboratory permeability testing that was conducted, where all but one of the samples indicated permeability of less than 10^{-6} cm/sec. The permeability under field conditions is

likely to be higher than that obtained from repacked samples in the laboratory. Moisture contents within the vadose zone suggests that at least a small amount of recharge is taking place to replenish moisture in the unsaturated zone. The average moisture content is about 15 percent on a weight/weight basis, which corresponds to a volumetric water content of about 26 percent. Based on soil boring lithologic logs (Appendix B), the materials are highly interbedded and zones with fewer fines are interspersed within the predominantly clayey material.

6.4 GROUNDWATER FLOW AND TRANSPORT MODELING RESULTS

The conceptual model of the site (Figures 2-5 and 2-6), along with properties of the chemicals, vadose zone, and saturated zone media, were used to develop simple analytical models to describe the fate and transport of constituents in the subsurface. Since screening levels were exceeded in groundwater at the source area, quantitative modeling was undertaken to predict concentrations at the property boundary for five selected representative analytes. Three phases of modeling were conducted to allow assessment of contaminant fate and transport at the site. These included estimates of potential recharge using the EPA Hydrologic Evaluation of Landfill Performance (HELP) model, assessment of contaminant mass flux in the vadose zone using the EPA VLEACH model, and analysis of transport and degradation in the aquifer using an analytical equation for three-dimensional reactive transport developed by Domenico (1987). Details are provided in Appendix K, while results are summarized below.

6.4.1 Recharge Modeling

Percolation of precipitation at the ground surface is the driving force that will lead to transport of dissolved phase contamination that is leached from contaminated soils. The source area at the site is currently paved, thus limiting the potential for generation of leachate; however, for analysis of future conditions, removal of the pavement and revegetation of the site was assumed as a possible scenario. A widely accepted water balance model was utilized to assess this potential future recharge. The EPA HELP (Schroeder et al. 1994). This model uses

climatological data, soil properties and site configuration to estimate the different components of the site water balance. Precipitation is partitioned into runoff, evapotranspiration, soil moisture storage and deep percolation. Appendix K provides summaries of estimated parameters that were guided by the site-specific soil data and information representative of these types of materials from the literature. Appendix K also presents model simulation results.

Climate data from the Los Angeles Basin was utilized in the recharge analysis. This modeling indicates that a yearly average of about 2 inches of recharge would be expected to occur if pavement were removed from the site. The current estimate of recharge was assumed to be 25 percent of this value; however, the current recharge estimate is highly uncertain. The observed moisture profiles and the fact that contamination has migrated to the water table supports the hypothesis that recharge through the source zone does take place. This range in recharge estimates was used to bracket the values used for simulation of transport through the vadose zone.

6.4.2 Vadose Zone Transport Evaluation

Elevated soil concentrations of chemicals of potential concern have been observed in the presumed source area at the site. This contamination extends from near the ground surface to the water table. Contaminants in the vadose zone may be associated with residual leaked fuel or non-aqueous phase liquids, may be sorbed onto soil and organic carbon coatings on the soil, may be in the vapor phase in pore space, or may be dissolved in moisture in the vadose zone. Contaminants will partition between the soils, vapor, and liquid phase in accordance with the soil and chemical properties. Dissolved phase contamination will migrate with percolating recharge to the water table.

Evaluations of vadose zone leaching and migration to groundwater were conducted with the EPA model VLEACH (Ravi and Johnson 1997). This is a screening model that uses a simplified approach to movement of water through the vadose zone. It uses a mass balance approach, calculating water velocity from the constant water content and the recharge rate. It does not include the effects of dispersion. In the model, contaminants are allowed to partition

between the phases using partitioning coefficients. Initial concentrations in the soil are used to define the mass of contaminant in the system. The model assumes that no degradation of constituents takes place and it does not limit partitioning based on solubility. Both of these assumptions will result in high estimates of the leachate concentration, leading to a conservative screening evaluation.

Simulated transport of each of the five indicator compounds of potential concern was conducted in the vadose zone using VLEACH and conservative parameter assumptions. One of these assumptions is that transport and partitioning only considers the liquid phase and the soil matrix, not volatilization. As noted above, the compounds were also assumed to not degrade in the vadose zone, since this is a screening model. This makes the estimates of concentration leaching to groundwater extremely conservative. Some loss of VOCs will take place via the vapor phase, especially for benzene and to a lesser degree 1,2-DCA. The percolating recharge water will carry some oxygen to the zone, as will convective transfer of air from the land surface.

Two recharge cases were used to define upper and lower limits on the rate of water movement through the vadose zone. The vertical domain of the model was set up with uniform soil properties and discretized into 26 one foot thick layers for the simulation. Soil concentrations from borings were used to set the initial conditions. Table 6-1 provides the depth distribution of concentrations for each of the compounds. Appendix K provides complete summaries of the input files for each of the simulations.

The time distribution of concentration was calculated for each of the five parameters over time in order to calculate loading rates to groundwater that may occur in the future. Loading rates were combined with groundwater in an assumed five-foot thick mixing zone in order to calculate concentrations in the source area. Figures 6-1 through 6-5 provide plots of these concentrations versus time in the future for each of the indicator compounds. As noted, these

concentrations are very conservative and significantly overestimate the actual mass of contaminant that will be leached.

Several general trends were noted in the simulation results, as follows:

- As expected, higher recharge rates lead to higher concentrations in the leachate, but more rapid depletion of the contaminant mass. Conversely, the lower recharge rate leads to lower leachate concentrations, but a longer duration of loading to groundwater.
- Benzene is present at relatively high concentrations in the soil in the source area and is highly leachable. Maximum simulated leachate concentrations for benzene ranged from 2,068 to 3,965 $\mu\text{g/L}$ for the bounding cases.
- Trimethylbenzene showed a range of 16,268 to 31,219 $\mu\text{g/L}$. The upper limit is over the solubility, thus the groundwater loading rate for the high recharge case is an overestimate of what is likely to take place.
- 1,2-DCA showed ranges of 40 to 76 $\mu\text{g/L}$. The mass of DCA in the soil is depleted in a relatively short time period, again leading to a conservative evaluation.
- Naphthalene takes a significant time period to reach its peak concentration range of 811 to 3,706 $\mu\text{g/L}$, due to its greater degree of sorption.
- Lead leachate ranges from 245 to 471 $\mu\text{g/L}$ in leachate.

For purposes of the groundwater evaluation, the maximum observed leachate loading rate was assumed to persist indicating continuing transport groundwater. This is a conservative assumption that will lead to an overestimate of groundwater concentrations.

The first-order source decay model assumes biodegradation starts immediately downgradient of the source and that it does not depress the concentrations of dissolved organics in the source zone itself.

The rate at which dissolved contaminants move through an aquifer can be reduced by sorption of contaminants to the solid aquifer matrix. The degree of retardation (R) depends on both aquifer and constituent properties and can be estimated from soil and chemical data using

variables described below P_b = bulk density, n = porosity, K_{oc} = organic carbon-water partition coefficient, K_d = distribution coefficient, and f_{oc} = fraction organic carbon on uncontaminated soil) with the following expression:

$$R = 1 + \frac{K_d \cdot \rho_b}{n} \quad \text{where} \quad K_d = K_{oc} \cdot f_{oc}$$

Assuming a first order decay rate (which is the same as R) for benzene, a modified simulated leachate concentration for benzene of 2.6 $\mu\text{g/L}$ resulted. This concentration was used in the saturated zone transport model in Section 6.4.3.

6.4.3 Saturated Zone Transport

Elevated concentrations of the five indicator compounds have been observed in groundwater in the source area near MW01, indicating that releases through the vadose zone have taken place. Continued releases from recharge moving through the vadose zone, residual fluids in the aquifer or its capillary fringe, and desorption from the aquifer matrix are possible sources of continuing releases. The aquifer appears to be confined based on observations during drilling at the site, so the capillary fringe may be absent. These confining conditions may also limit the potential for residual non-aqueous fluids in the aquifer itself. Processes that are important in the saturated zone include mixing and dispersion, sorption, and desorption from the aquifer matrix, as well as biodegradation. These processes were evaluated using an analytical model that considers transport from a two dimensional source in the y-z plane subject to advection, dispersion, adsorption, and first order decay processes (Domenico 1987).

This approach assumes a constant groundwater velocity, which was calculated to be about 0.045 feet/day based on site data. Sorption characteristics are included in the retardation factor, which was summarized for the five constituents in Table 6-1. First order degradation rates, summarized on Table 6-1, were developed based on an assumption that the current plumes have reached a steady state. The rationale for this assumption is discussed in Section 6.5. The dispersivity term was estimated using literature data at about 10 feet.

Simulations were conducted for three of the compounds that appear to be persistent in groundwater for some distance from the source and would be expected to be somewhat mobile based on chemical characteristics. These simulations were conducted for benzene, TMBs and 1,2-DCA. Based on modeling results these compounds reach a steady state within a 10 to 30 year period, where concentrations in the plume do not change if the source strength remains the same. For this reason, all simulations were run for a 50 year period. Results of all of these model simulations are presented as concentration versus distance from source area in Appendix K. Each compound was simulated for three conditions,

- Assumption that currently observed maximum groundwater concentrations persist at the source area into the future;
- Concentrations simulated in the vadose zone evaluation for the low recharge case persist at the source area into the future and;
- Concentrations simulated in the vadose zone evaluation for the high recharge case persist at the source area into the future.

Table 6-3 summarizes the simulated steady state concentration at the site boundary for each of the simulated cases. It should be noted that the simulation results for the soil leachate projections are very conservative, while the first case (where the currently observed concentrations in groundwater are used as the source term) are considered more realistic.

Using the less conservative source decay model results identified in Section 6.4.2.1, the more realistic benzene result shown in Table 6-3 is 0.1 µg/L, which is below the MCL.

6.4.4 NATURAL ATTENUATION POTENTIAL

The Lawrence Livermore National Laboratory (LLNL) Leaking UST Cleanup Report released in October 1995 (LLNL 1995) found that environmental impacts resulting from the release of fuel hydrocarbons from leaking USTs are not as severe as once thought. In many instances where groundwater is contaminated with fuel hydrocarbons, natural degradation processes alone will reduce contaminant concentrations (Air Force Center for Environmental Excellence

[AFCEE] 1995). AFCEE has developed protocol to evaluate the fate of fuel hydrocarbons in groundwater; use of this protocol enables an assessment of whether natural degradation processes, (i.e., passive biodegradation) will be sufficient to reduce contaminant concentrations to below regulatory standards before potential exposure pathways are completed.

Chlorinated solvents do not naturally degrade as readily as petroleum hydrocarbons. Biodegradation of chlorinated compounds proceeds best under anaerobic conditions. The EPA has finalized guidance addressing the use of natural attenuation processes as one element of a monitored natural attenuation corrective action at RCRA, CERCLA, and leaking UST sites (EPA 1999). Many state agencies have also accepted use of the natural attenuation approach with appropriate monitoring where site conditions are appropriate. Use of these passive alternatives often is combined with long-term monitoring and source control.

The degradation of contaminants in groundwater has been observed at numerous sites and the processes responsible have been studied extensively. The processes that lead to the decrease in contaminant mass are referred to as natural attenuation. Processes that contribute to natural attenuation may include aerobic and anaerobic biodegradation, abiotic degradation, dispersion, sorption, volatilization, transformation, destruction, and dilution.

Several lines of evidence may be used to assess the degree to which natural attenuation processes are active in controlling contaminant migration at a site.

- When long-term monitoring data is available, demonstration that the plume extent is stable or shrinking provides good evidence that natural attenuation is effective.
- Another applicable technique to assess these processes is comparison of degradable compound distributions with refractory compound concentrations. If it can be demonstrated that the degradable compound does not extend as far as a refractory compound with similar source history and sorption properties, then this is presumptive evidence of natural attenuation.

- A third line of evidence relates to examination of breakdown products from degradation of a compound and decreases in electron acceptor compounds or metabolic byproducts of biotic degradation. An example of this method would be a typical loss of dissolved oxygen within a hydrocarbon plume. Aerobic degradation will take place at fringe areas of hydrocarbon plumes and rapidly consume available dissolved oxygen in the groundwater. Research at numerous sites has shown that prevalent reactions will first consume oxygen in aerobic biodegradation. If nitrate is present, then denitrification may facilitate anaerobic degradation of hydrocarbons. If conditions become more reducing, then reduction of iron to the ferrous state may be used as the electron acceptor. More reducing conditions may subsequently lead to sulfate reduction or methanogenesis. Examination of trends of electron acceptor concentrations within and downgradient of the contaminant plume can indicate if these reactions are active.

Groundwater sampling for parameters indicative of natural attenuation processes was conducted between November 1999 and February 2000. Sampling and analysis results were evaluated to assess whether indications of biodegradation are present at the site.

These data have limitations that restrict their use for confirming precise degradation rates and mechanisms active at the site. Conflicting data on the geochemical conditions were identified, possibly due to field sampling procedures and the well construction activities.

- Measurement of dissolved oxygen and redox potential may have been affected by aeration during sampling.
- Well screens extend over a number of feet and produce water that is both within zones where probable degradation is taking place and intervals that are minimally affected by the contamination.

6.4.5 VOCs

The primary VOC contaminants detected in soil and groundwater samples collected from the site are derived from gasoline-related sources. These include BTEX (primarily benzene), trimethylbenzene isomers (TMBs), and 1,2-dichloroethane (1,2-DCA). The subsurface

biological fate of each of these contaminants is well documented in the literature and is a function of the reducing environment in which the contaminants are present.

BTEX compounds have an aromatic structure that is subject to biodegradation and ultimate detoxification under both aerobic and anaerobic environments. Furthermore, the biodegradation rate of BTEX compounds generally decreases as the environment in which they are found becomes more electrochemically reduced. Thus, the fastest biodegradation rates of BTEX compounds generally occurs in the more oxidized environments (e.g., aerobic, nitrate-reducing)

TMB isomers are fairly recalcitrant under anaerobic environments and often serve as conservative tracers in such environments; however, these compounds are readily biodegraded in aerobic environments.

1,2-DCA is subject to aerobic biodegradation and may be biodegradable under various anaerobic environments. Under aerobic conditions, 1,2-DCA may be oxidized to 2-chloroethanol and 2-chloroacetate, which are then readily mineralized to innocuous end products. Although oxidation of 1,2-DCA to carbon dioxide and water under nitrate-reducing conditions in the laboratory has been postulated by one research group (Gerritse et. al. 1999), this pathway is not widely accepted and has not been confirmed *in-situ*.

6.4.6 General Chemistry Results

Electron acceptor and metabolic byproduct data suggest that groundwater near and hydraulically downgradient of the vehicle maintenance building is primarily under nitrate-reducing conditions, although minimal sulfate reduction may be occurring.

Dissolved oxygen (DO) concentrations in groundwater range from 1.3 mg/L (MW02) to 5.1 mg/L (GG01) and suggest that aerobic groundwater conditions exist throughout the site. However, samples collected for DO readings are believed to be artificially elevated because

aeration likely occurred during purging and sampling activities. Therefore, DO data may not be valid.

Specifically, nitrate concentrations throughout the majority of the contaminant plume range from 11.5 to 42.5 mg/L, with the lowest concentrations recorded in the upgradient region of the plume at GG01 (11.5 mg/L), MW02 (13.2 mg/L), and MW01 (13.5 mg/L). These reduced nitrate concentrations in the center of the plume suggest that groundwater is reduced at least to the level of nitrate reduction is occurring.

To further evaluate nitrate reduction as a terminal electron accepting process of natural attenuation, the assimilative capacity for BTEX/TMB and 1,2-DCA biodegradation was calculated. The assimilative capacity is defined as the amount of contaminant that can be degraded for a given amount of terminal electron acceptor, in this case nitrate. The assimilative capacity was calculated using terminal maximum concentrations of BTEX/TMB and 1,2-DCA observed in groundwater and the stoichiometric relationship between complete oxidation of each compound to carbon dioxide and reduction of nitrate to dinitrogen gas. A result of 5.7 mg/L of nitrate as nitrogen would be required to completely degrade the maximum concentrations of BTEX/TMB and 1,2-DCA observed in groundwater. Considering that other organic carbon may be present in groundwater, the result compares favorably to the observed consumption of about 31 mg/L. These data support the observation of nitrate reduction as a terminal electron accepting process and mechanism of biodegradation at the site.

Field measurements of dissolved concentrations of ferrous iron (Fe^{+2}), the metabolic by-product of ferric iron reduction, were all below analytical detection limits. In addition, total iron concentrations are low, ranging from below analytical detection limits to 3.0 mg/L (MW01). Low concentrations of total iron suggest iron reduction may be occurring at this site but not enough data are available to be certain.

Sulfate concentrations throughout the VOC-contaminated regions are moderately high, ranging from 518 mg/L (MW02) to 880 mg/L (MW05). The lowest sulfate concentrations are found in the upgradient region of the VOC plume at GG01 (540 mg/L), MW02 (518 mg/L), and GG02 (522 mg/L). Not enough data exist to support a conclusion that sulfate reducing conditions in this area.

Finally, methane concentrations are below analytical detection limits and suggest that highly reduced methanogenic conditions are not established.

In summary, depressed (yet persistent) nitrate concentrations in the upgradient regions of the VOC contaminant plume suggest that groundwater is predominantly under nitrate reducing conditions. It is presumed that highly reduced groundwater conditions are limited by the availability of electron-donating compounds (e.g., fuel hydrocarbon contaminants, natural organic matter, or other).

6.4.7 Degradation Assessment

The establishment of nitrate to sulfate reducing groundwater conditions suggests the rapid to moderate biodegradation of BTEX compounds, with only limited biotransformation of TMB isomers and 1,2-DCA, if any. These findings are consistent with VOC concentration isoconcentration maps, in which benzene migration is limited to the upgradient regions of the contaminant plume (presumably due to significant biodegradation) while TMB and 1,2-DCA migration extends beyond the benzene plume. It should be noted that comparison of the VOC plume lengths assumes a similar source release timeframe, and may be complicated by other natural attenuation mechanisms (e.g., sorption, volatilization, etc.). Preliminary estimates of VOC first-order decay rates were estimated using the method of Buscheck and Alcantar (1995). The basis of these techniques, inherent assumptions, and methods of estimation are outlined in detail in the Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater (USEPA 1998b). Biotransformation rate estimates calculations are included in Appendix K and the results were summarized in Table 6-1.

Data presented in Table 6-1 indicates appreciable benzene first-order decay. In contrast, first-order decay constants for 1,2-DCA and TMB are low. A low first-order decay coefficient for the TMB isomers is expected since these contaminants are fairly recalcitrant under nitrate- to mildly sulfate-reducing conditions. Finally, low 1,2-DCA decay rate estimates are expected since oxidation of this compound is not likely to be significant under nitrate- to sulfate-reducing conditions.

Comparison of the plume extent of TMB with other constituents also provides evidence that degradation of benzene is significant at the site. Under the anaerobic conditions within the plume, TMB should be minimally degraded. The areal extent of TMB is much greater than that of benzene, even though source area concentrations are within a factor of about 3 of each other and the retardation factor of TMB is much higher. This indicates that benzene mass is decreasing in groundwater.

6.4.8 Summary

Multiple lines of evidence at the site show that biodegradation processes are active at the site. Dissolved oxygen data are ambiguous due to measurement and well construction activities; however, the core of the plume area appears to be lower in dissolved oxygen content. Likewise, a trend of lower nitrate concentration in the source area suggests that anaerobic denitrification is responsible for additional hydrocarbon degradation. Comparison of plume extents for benzene and TMB also indicate loss of mass of benzene at the site due to degradation.

6.5 CONCLUSIONS

Site data and modeling results indicate that leaching from the vadose zone will persist into the future and that this leachate will affect groundwater in the source area. The contaminants in groundwater at the source area are transported a limited distance due to the natural attenuation

processes that are active at the site. The site is anaerobic at the source and downgradient. Conditions appear to be favorable for plume stabilization by these processes. Since the plumes appear to be at steady state, significant expansion in the area of contamination is unlikely unless the source release rate changes, in which case the modeled results assuming increased infiltration (resulting from pavement removal) indicated greater contamination migration.

6.6 Estimated Exposure Dose and Cancer Risk from Soil to Gas to Indoor Air

The redevelopment process begins with a vision of reuse and/or restoration of a property or properties based on a public need or business opportunity. The successful implementation of the redevelopment process is dependent on a clear understanding of the environmental conditions and identification of the environmental risks associated with the property(s).

In preparing the risk assessment, volatilization of contaminants located in subsurface soils or in groundwater and the subsequent mass transport of these vapors into indoor spaces constitutes a potential inhalation exposure pathway was evaluated. A modification of the USEPA NAPL-ADV (2000) screening-level model was developed to incorporate both convective and diffusive mechanisms for estimating the transport of contaminant vapors emanating from either subsurface soils or groundwater into indoor spaces located directly above the source of contamination.

The modified model is a two dimensional analytical solution to convective and diffusive vapor transport into indoor spaces and provides an estimated attenuation coefficient that relates the vapor concentration in the indoor space to the vapor concentration at the source of contamination. The model is constructed as both a steady-state solution to vapor transport (infinite or non-diminishing source) and as a quasi-steady-state solution (finite or diminishing source).

The model calculates the total amount of dissolved contaminant using complex calculation techniques; the chemical concentration is multiplied by velocity, the depth, and thickness of the array zone. The model is a screening-level tool for evaluating vapor intrusion from soil or groundwater into indoor air.

6.6.1 The Conceptual 2 Dimensional Vapor, Soil and Pore Water Intrusion Model

The modified model uses site-specific and/or generic information for sensitive variables when available. The model incorporates site geology and hydrology (thickness of vadose zone; soil porosity; hydraulic conductivity). It analyzes the nature and extent of contamination (depth to soil or groundwater source; thickness of soil source area). It calculates for building-specific parameters (indoor air exchange rate; vapor infiltration area) as well as receptor-specific parameters (exposure frequency; exposure duration). More specifically the modified 2 dimensional model addresses the following:

- Chemicals partition from groundwater or soil to soil gas under assumed equilibrium conditions.
- Soil gas migrating through the soil column under convective influence from an overlying building.
- Convective influence of a building created by negative pressure in the building which is caused by wind movement past building, heating, and mechanical ventilation, causing soil gas to be pulled through cracks in the foundation. Cracks in the foundation are assumed to be represented by the seam that typically might exist between a concrete floor slab and walls or footers.
- Soil gas that may be pulled into the interior space of a building that is diluted into the interior volume of the building.
- Future land use receptors occupying the buildings breathing interior air that may be potentially contaminated by soil gas migration into the building.

6.6.2 Model Input Variables

The modified model uses input parameters to generally influence one of five model components. The parameters manipulate chemical partitioning from soil or groundwater to soil gas, generally the chemical specific impacted variables (components) are:

- Henry's law constant
- Temperature of soil or groundwater source
- Air and water diffusion coefficients
- Fraction organic carbon in soil
- Soil bulk density

The modified model evaluates three major potential exposure transport considerations for receptor uptake, which are as follows:

1. Soil gas migration within the soil column: generally, environmental variables that are based on soil type and influence of the attenuation of vapor movement within the soil column.

These variables include:

- Saturated hydraulic conductivity
- Total soil porosity
- Water content of soil: ratio of air-filled to water-filled porosity
- Thickness of capillary fringe

2. Vapor flow into building: generally, building-specific parameters that influence the area of cracks (seams) that are below grade (and thus the potential vapor infiltration area) as well as the distance from the vapor source in soil or groundwater to the point of infiltration.

These parameters include:

- Depth of floor below grade

- Thickness of walls and/or floor that is below grade
- Floor-wall seam perimeter distance
- Crack radius
- Subsurface: Interior pressure differential

3. Vapor dilution within building: generally, building-specific parameters that determine the rate of indoor air exchange. As the rate of indoor air exchange to rate of vapor infiltration increases, the indoor air contaminant concentrations decrease. These parameters include:

- Building air exchange rate
- Interior volume of building

6.6.3 Model Limitations

The modified 2 dimensional intrusion model has the following inherent limitations:

- Does not account for preferential vapor migration pathways (e.g., fractures in clay)
- Not applicable for environmental conditions in which groundwater or the top of the capillary fringe contacts the bottom of the building floor slab
- Not applicable for evaluating vapor migration from soil beneath a layer of groundwater (e.g., perched groundwater conditions)

Uncertainty with evaluation of vapor migration from non-aqueous phase liquids. Modeled results can be found in appendix K.

Table 6-1
Transport-Related Chemical Properties for Indicator Compounds

Chemical	Organic Carbon Partitioning Coefficient [K _{oc}] (ml/g)	Solubility (mg/l)	Soil/Water Partitioning Coefficient [K _d] (ml/g) ^a	Degradation Rate (yr ⁻¹)	Retardation Factor [R] ²
Benzene	89	1780	0.06141	0.28	1.28
1,3,5-Trimethylbenzene	799	20	0.55131	0.1	3.52
Naphthalene	1300	30.8	0.897	--	5.1
1,2-Dichloroethane	71	8524	0.04899	0.11	1.22
Lead	--	--	--	--	392

Notes:

a Use fraction organic carbon of 0.00069

b Bulk density 1.6, porosity 0.35

ml/g = milliliters per gram

mg/l = milligrams per liter

yr = year

Table 6-2
Soil Concentrations used in VLEACH Model, NMCRC-LA

Depths (feet)	1,2 DCA Concentration (μg/kg)	Benzene Concentration (μg/kg)	TMB Concentration (μg/kg)	Naphthalene Concentration (μg/kg)	Lead Concentration (μg/kg)
1-3	0	0	0	0	7600
4-7	1	10	1850	5	7600
8-12	3	23	5	1300	7600
13-17	3	279	9747	7300	7600
18-22	1	61	9050	3100	7600
23-26	12	698	27200	1700	7600

Notes:

Depth intervals based on samples collected at 5-foot intervals and groundwater at 26 feet

bgs = Below ground surface

DCA = Dichloroethane

NMCRC-LA = Naval and Marine Corps Reserve Center - Los Angeles

TMB = 1,3,5 Trimethylbenzene

μg/kg = micrograms per kilogram

Table 6-3
Ground Water Concentrations at Property Boundary, NMCRC-LA

Groundwater Source Concentration	Concentration at Property Boundary (µg/L)		
	1,2 DCA	Benzene	TMB
Observed in Groundwater	0	1	1
Leachate-dry case	0	2	13
Leachate-wet case	1	4	26
Source Decay	NA	0.1	NA

Notes:

Concentrations based on 3-dimensional analytical solution of Domenico (1987) for constant source, decaying and sorbing solutes, for 50 years of transport.

Leachate scenarios derived from VLEACH and HELP results using 2 and 0.5 inch/year precip for wet and dry cases, respectively. Property boundary is approximately 240 feet from the source location.

DCA = Dichloroethane

NMCRC-LA = Naval and Marine Corps Reserve Center -Los Angeles

TMB = Total Trimethylbenzenes

µg/l = micrograms per liter

NA = Not analyzed

Figure 6-1 Leachate Concentrations - Benzene

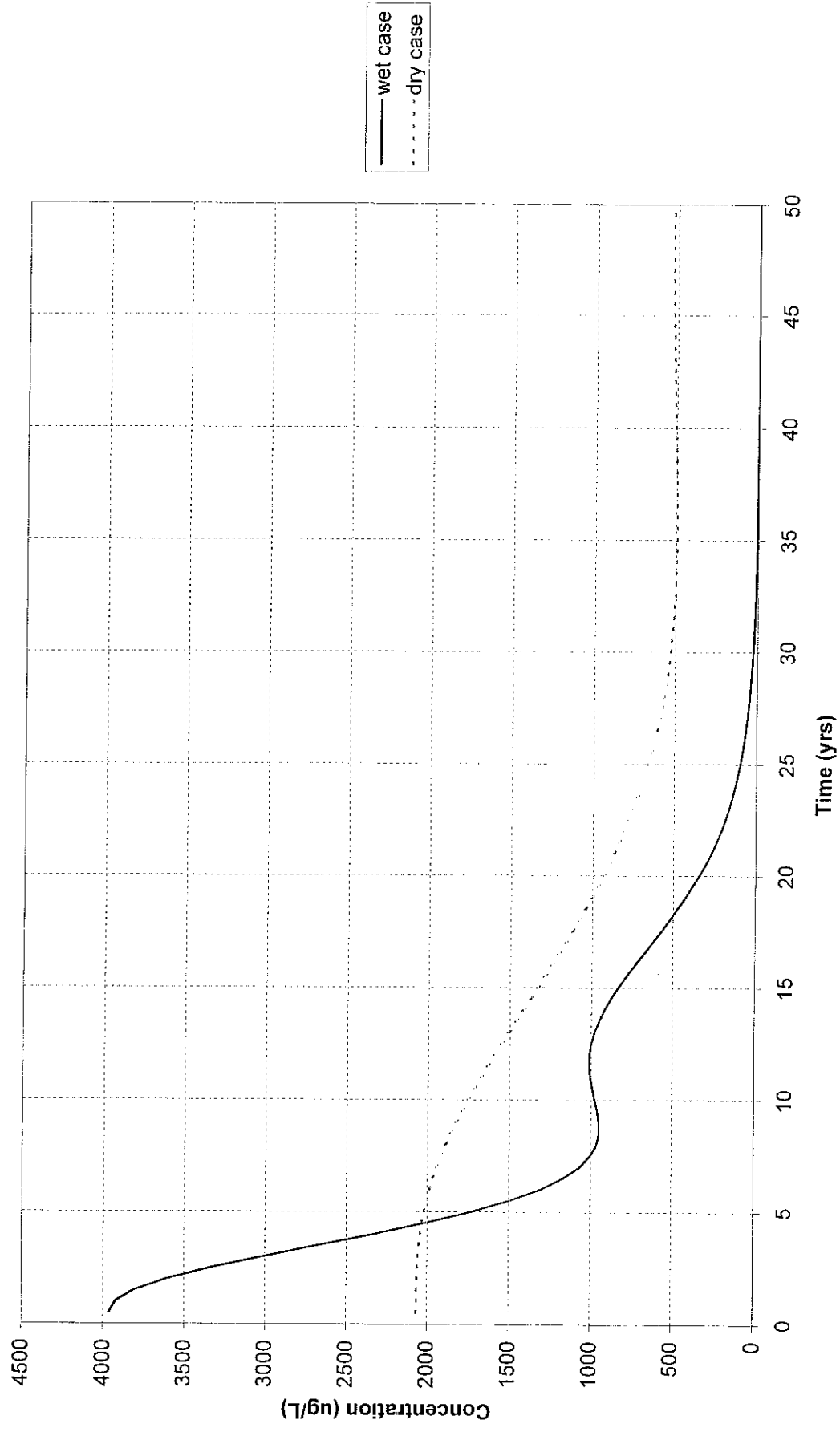


Figure 6-2 Leachate Concentrations - 1,3,5 TriMethylBenzene

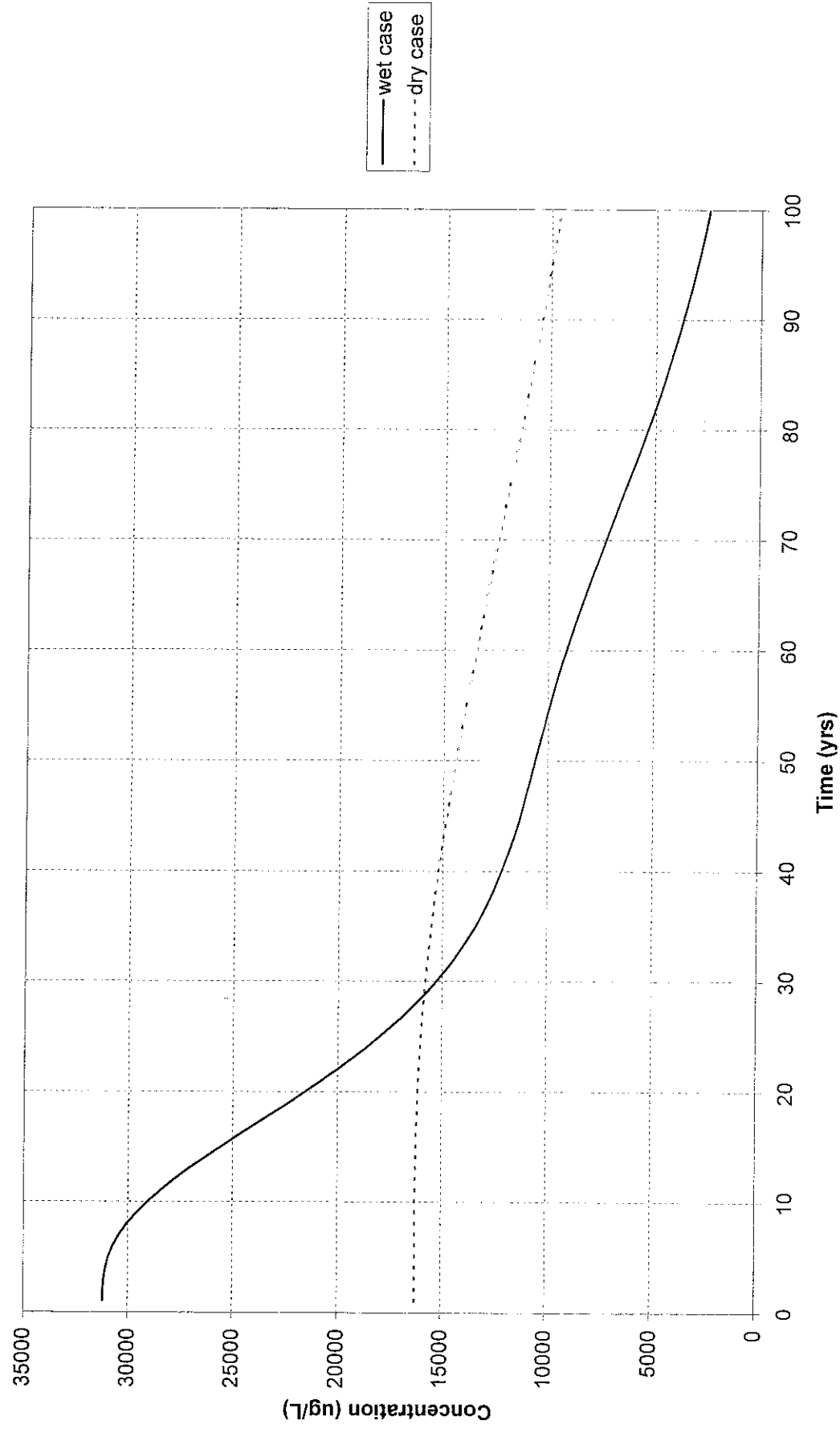


Figure 6-3 Leachate Concentrations - 1,2 DCA

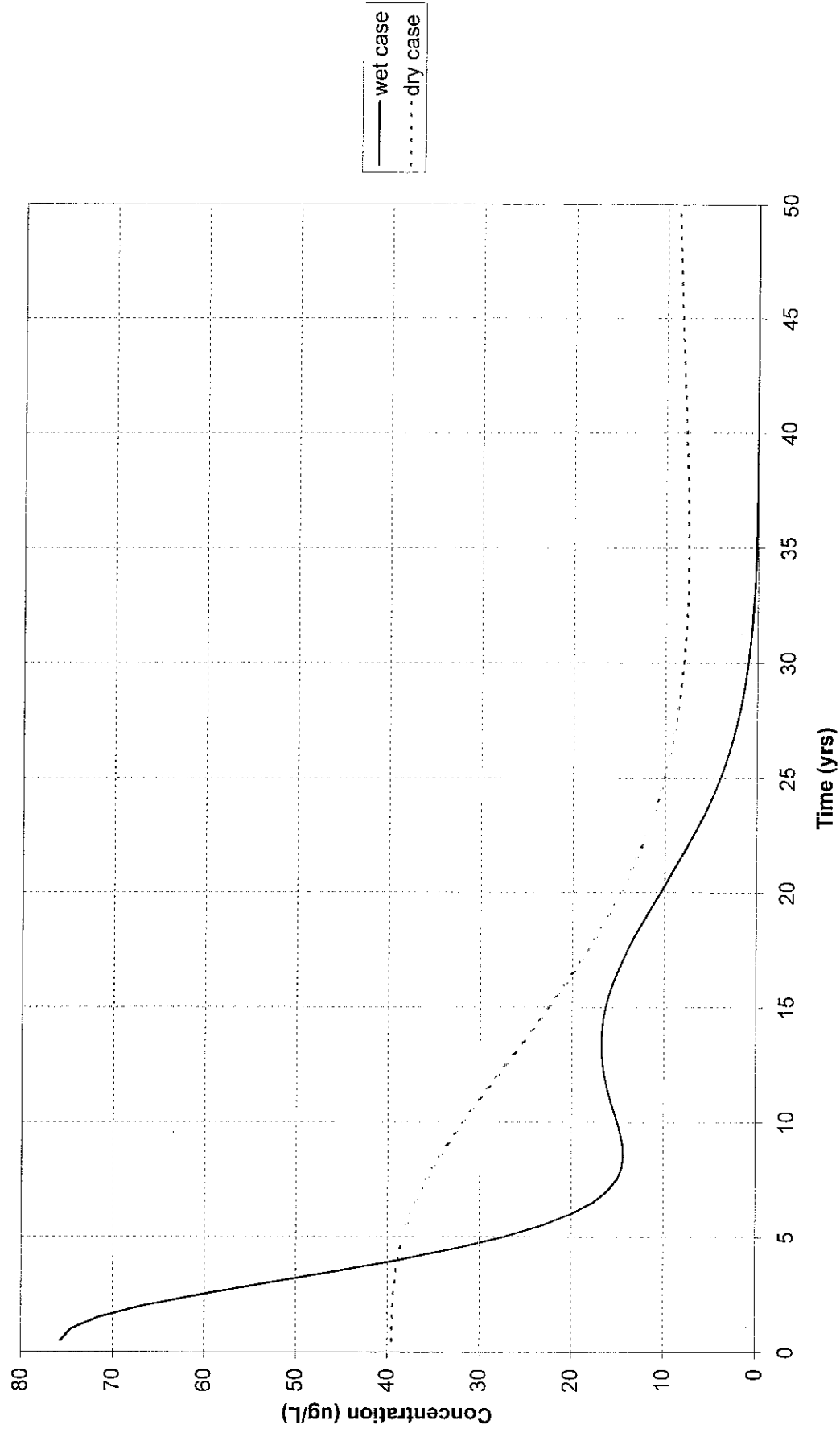


Figure 6-4 Leachate Concentrations - Naphthalene

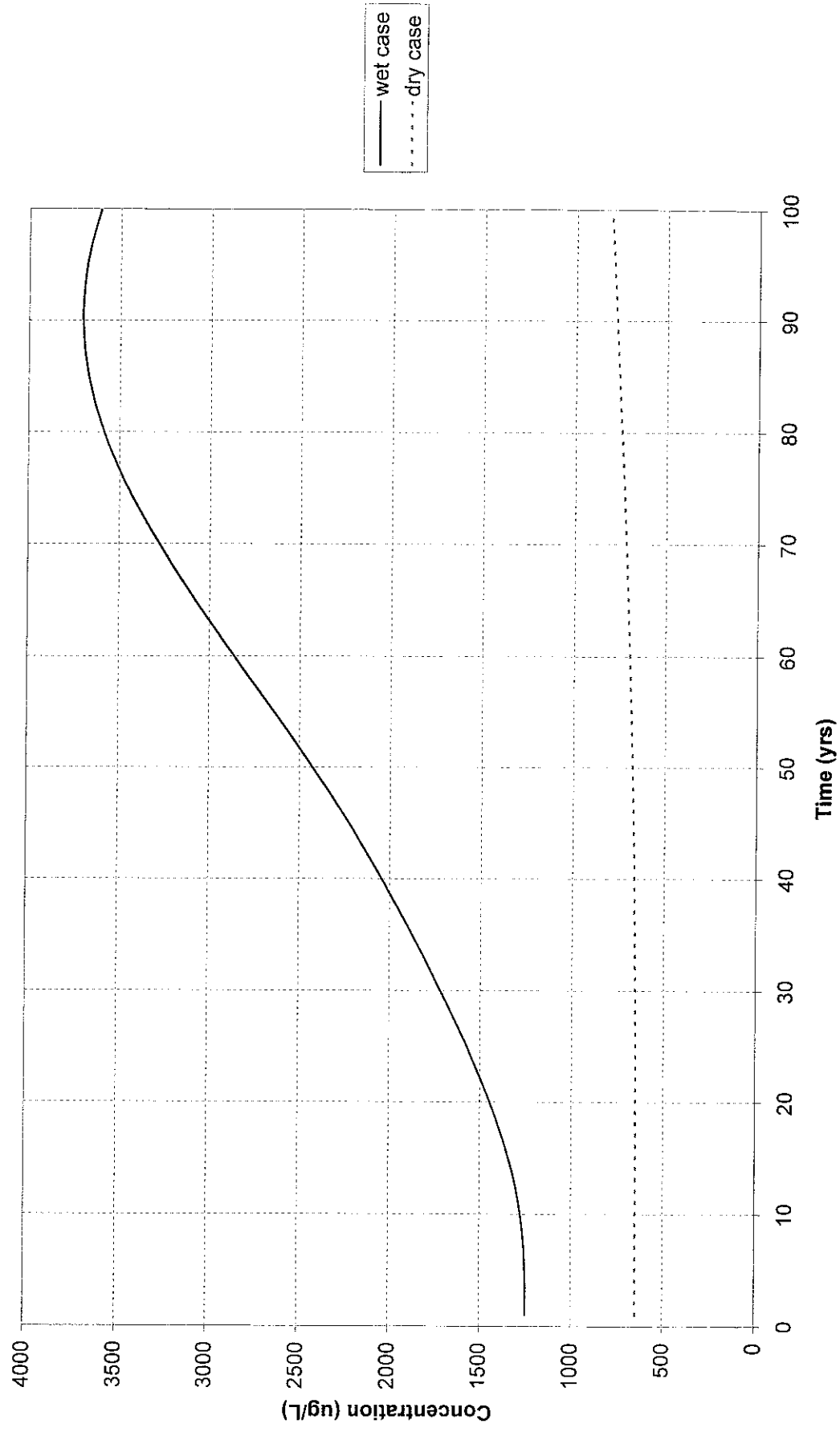
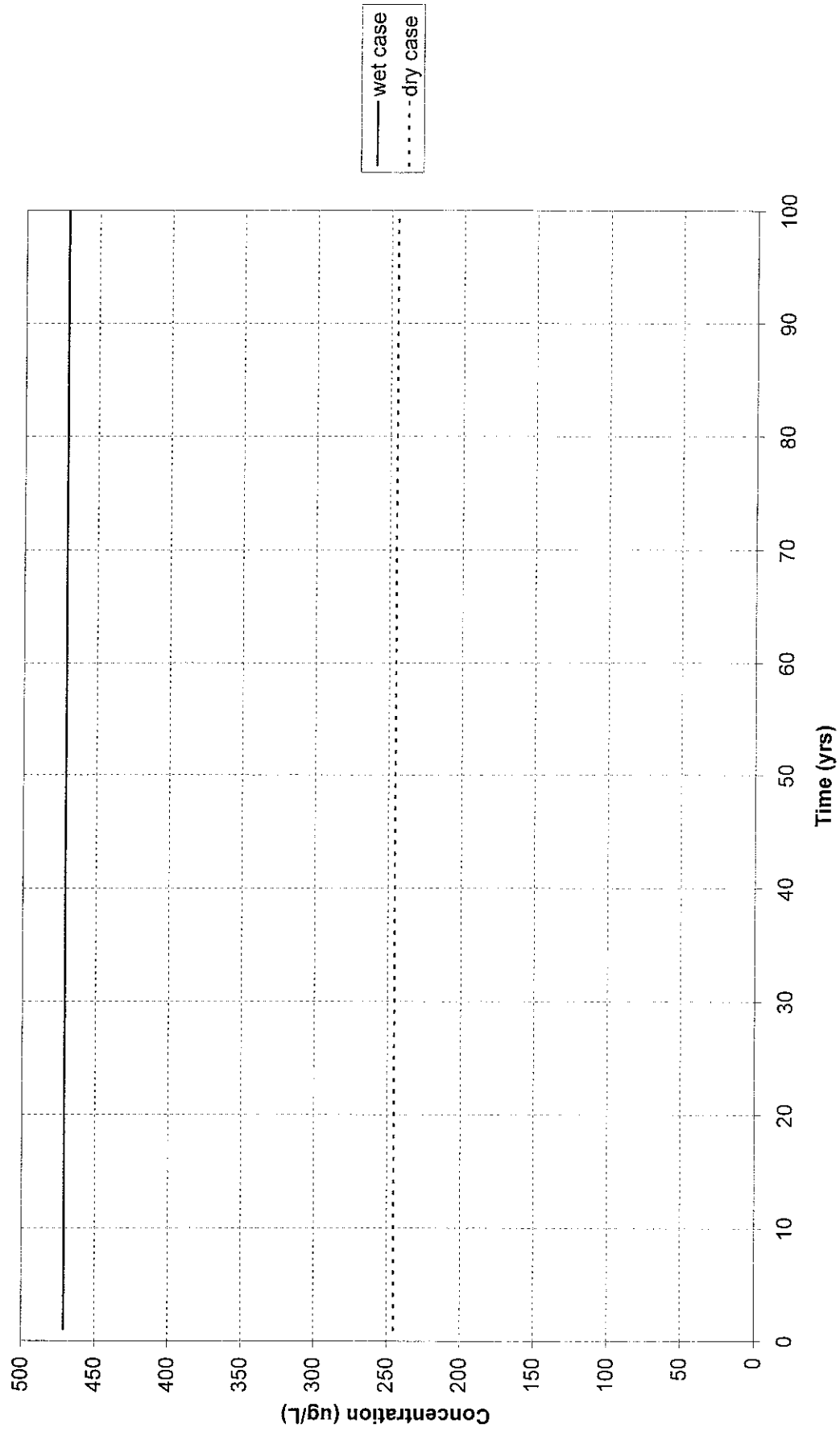


Figure 6-5 Leachate Concentrations - Lead



7.0 HUMAN HEALTH RISK ASSESSMENT

This section presents an assessment of the potential for human health effects to occur from exposures to site contaminants in soil and groundwater (see Section 4). The HHRA follows EPA and Cal/EPA risk assessment methodologies and is a baseline evaluation that assumes no remedial action will occur at the site. The no-action alternative is evaluated in accordance with Section 330.430(d) of the NCP.

Section 7.0 is organized as follows:

- Section 7.1 Overview of the methods used to prepare the HHRA;
- Section 7.2 Identification of chemicals of potential concern (COPCs);
- Section 7.3 HHRA exposure scenarios and parameters;
- Section 7.4 HHRA results; and
- Section 7.5 Significance of HHRA results.

Detailed technical information that was used to assess risks and hazards posed by soil and groundwater contaminants at the NMCRC-LA site is presented in Appendix L and includes the following:

- L.1 Procedures used for selection of the HHRA parameters;
- L.2 Exposure assessment, which identifies potential human receptors, potential exposure pathways, and exposure calculation parameters;
- L.3 Toxicity criteria for COPCs for both carcinogens and non-carcinogens;
- L.4 Estimates of human health cancer risk, toxicological hazard, and child blood-lead levels that could potentially result from exposure to site soil and groundwater contaminants;
- L.5 HHRA results; and
- L.6 Discussion of uncertainties associated with the risk assessment.

7.1 OVERVIEW OF METHODOLOGY

An HHRA assesses the likelihood of an adverse health effect occurring as a result of exposure to contaminants. The HHRA for NMCRC-LA focuses on soil and groundwater contamination resulting from releases from the gasoline UST formerly located on the site. The following factors were evaluated to ensure that appropriate parameters were used in the preparation of the NMCRC-LA HHRA:

- Identification of the area of concern (NMCRC-LA);
- Identification of the media of concern (e.g., soil);
- Identification of COPCs;
- Identification of data used to calculate exposures and risks;
- Identification of current and future land uses and human receptors of concern;
- Identification of exposure pathways of concern based on receptors, land uses, and media of concern; and
- Selection of exposure assumptions to describe the potential exposure to receptors of concern.

The following sections summarize the most significant results of the evaluation and results of the risk characterization. The evaluation is discussed in detail in Appendix L. Figure 7-1 presents a flow chart showing the risk assessment process that was used.

7.2 IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN

Chemicals of potential concern are those analytes that are potentially site-related (i.e., released from the gasoline UST), that have data of sufficient quality for use in the quantitative risk assessment, and that are present at concentrations greater than background levels (EPA 1989). Identification of a chemical as a COPC is not indicative of the potential health risk posed by the chemical. Cal/EPA guidance (Cal/EPA 1994) indicates that risk-based screening levels may not be used to eliminate chemicals as COPCs due to the need to evaluate cumulative risk.

As indicated in previous sections, several chemicals exceed EPA Region 9 PRGs, however, this was not the criteria used to retain or eliminate chemicals as COPCs.

Total petroleum hydrocarbon analyses (i.e., TPH-gasoline, TPH-diesel, and TPH-motor oil) were not evaluated in this HHRA as COPCs because they represent concentrations of a group of many analytes. Individual fuel analytes (e.g., benzene, trimethylbenzene) were analyzed and reported separately. Individual fuel analytes are specifically excluded from CERCLA regulation by CERCLA section 101(14), which excludes "petroleum, including crude oil or any fraction thereof" unless specifically listed or designated under CERCLA. However, analytes that are likely to be associated with petroleum were not excluded from the HHRA.

Soil and groundwater analytes other than TPH were screened for inclusion as COPCs. Analytes that were not detected in any samples were not included as COPCs. Inorganic analyte concentrations were compared to background concentrations. Section 4.3 and Appendix J include the results of statistical evaluations used to identify background concentrations in soil and groundwater. Metal concentrations in soil and groundwater that were considered to be present at background concentrations were excluded from this HHRA as COPCs. Table 7-1 presents the list of COPCs for soil and groundwater, and identifies the COPCs that are likely to be associated with petroleum contamination.

7.3 HHRA EXPOSURE SCENARIOS AND PARAMETERS

Characterizing exposure scenarios involves evaluating the exposure setting, which includes the physical characteristics of a site (e.g., presence of pavement or drinking water wells), current and potential future human populations on and/or near the site, and selection of health protective exposure parameters for the risk and hazard models.

7.3.1 Characterization of Exposure Setting

The location and setting of NMCRC-LA is described in Section 2.0. In summary, the site is located one mile northeast of downtown Los Angeles in an urban area. Dodger Stadium and Elysian Park are located north of the site. The NMCRC-LA site is paved with cement and/or asphalt and has a chain link fencing surrounding the entire site. Ecological receptors are not present onsite due to the lack of habitat, as discussed in Section 2.5. The site is currently used by the City of Los Angeles Fire Department for training purposes. An ecological risk assessment was not performed because of the following:

- NMCRC-LA is almost entirely paved and all areas of the property have been disturbed;
- NMCRC-LA has little vegetation on-site and the majority of the vegetation is used for landscape purposes;
- NMCRC-LA is highly developed and has no potential for sensitive plant species to exist; and
- According to the EBS, no threatened or endangered species were encountered (BNI 1995).

7.3.2 Potentially Exposed Human Populations

Although the City of Los Angeles Fire Department currently uses the site for training, there is a potential exposure inhalation pathway of VOCs that might have migrated through soil and into the ambient air. This pathway is considered applicable as a result of cracks in the cement/asphalt pavement. The drinking water pathway scenario was also evaluated; however because public city water is provided and the lack of drinking wells in this area, this current scenario was not considered for inclusion in this HHRA. Human populations potentially exposed to site contaminants in the future could include:

- Construction workers
- Industrial/commercial workers
- Hypothetical Residents

Potential pathways through which these future human populations might be exposed are discussed below.

7.3.3 Identification of Exposure Pathways and Exposure Assumptions

An exposure pathway consists of the following elements:

- A chemical source and mechanism of release;
- An environmental transport medium for the released chemical;
- A point of potential human contact with the contaminated medium; and
- A route of exposure (e.g., inhalation, ingestion, or dermal absorption) into the receptor.

The absence of any one of these elements would result in an incomplete exposure pathway. For example, individuals driving across the site in an enclosed vehicle may have no point of contact with contaminated soil. Incomplete exposure pathways are not evaluated in this HHRA.

The former gasoline UST and the presence of several drums of unknown waste at the lube rack are potential historical sources of contamination at the NMCRC-LA site. Contaminated subsurface soils and groundwater below the area of concern are potential current sources of contamination. The potential exposure media consist of soil and groundwater.

As described above, humans do not currently have a point of contact with site contaminants. Changes in site characteristics (e.g., removal of paved covering, installation of drinking water wells, soil movement/mixing from construction activities) would have to occur for future human receptors to have a point of contact with site contaminants. Potential scenarios and pathways through which humans might be exposed in the future consist of the following:

- Exposure of construction workers to site contaminants through incidental soil ingestion, dermal contact with soil, and inhalation of particulates and VOCs. This might occur during activities such as excavation of soil during construction of a building foundation.
- Industrial exposure to site contaminants through incidental soil ingestion, dermal contact with soil, and inhalation of particulates and VOCs. This scenario would require removal of the pavement covering the site and industrial development of the site.
- Residential exposure to site contaminants through incidental soil ingestion, dermal contact with soil, and inhalation of particulates and VOCs. This scenario would require removal of the pavement covering the site and residential development of the site.
- Residential exposure to site contaminants in groundwater. This scenario would require installation of groundwater wells for domestic use in the contaminated plume or in a downgradient area potentially impacted by the plume. This could result in exposure to contaminants in groundwater through ingestion, inhalation (i.e., vaporization of volatile contaminants during showering), and dermal exposure (i.e., skin contact during showering).

These scenarios are considered unlikely to occur due to the planned future use of the site. Evaluation of these scenarios for potential impacts to human health was performed to provide a conservative estimate of the potential future risks presented by site contamination. Exposure scenarios and pathways are summarized in Table 7-2.

Exposure parameters are used in conjunction with the exposure point concentration (discussed below) to evaluate the level of exposure (i.e., exposure duration, frequency, and rate) that construction workers, industrial workers, and residents might have with contaminated media. The exposure parameters selected are based on EPA recommendations for estimates of reasonable maximum exposure (EPA 1989). Use of upper-bound exposure parameters ensures that the estimates of exposure and risk are conservative. The exposure parameters used for this HHRA are presented in Table 7-3.

The exposure point concentration is the average chemical concentration a receptor will contact over an exposure period. Because of the uncertainty associated with estimating the average concentration at a site, the 95 percent upper confidence limit (95% UCL) of the arithmetic mean is used as the exposure point concentration. The equation used to calculate the 95% UCL of the arithmetic mean is based on data distribution. A lognormal distribution was assumed unless evaluation of the data indicated otherwise. In some instances where there was a great degree of variability in measured concentrations, the 95% UCL of the arithmetic mean was greater than the maximum detected value. In those instances, EPA recommends the use of the maximum detected value as the exposure point concentration. For this HHRA, therefore, the lesser of the 95% UCL of the arithmetic mean and the maximum concentration was used as the exposure point concentration. Data summary statistics are presented in Tables 7-4 and 7-5 for soil and groundwater, respectively.

7.4 HUMAN HEALTH RISK ASSESSMENT RESULTS

The following section presents the results of the HHRA for future exposure scenarios for construction workers, industrial workers, and residents that could potentially be exposed to subsurface soils and groundwater at NMCRC-LA. Tables 7-6 through 7-11 summarize these results.

7.4.1 Construction Scenario

The cumulative excess lifetime cancer risk for the soil pathway for potential future construction workers was 2×10^{-9} . The majority of this total cancer risk was associated with petroleum-related analytes. The cumulative excess lifetime cancer risk for chemicals that are not related to petroleum was only 9×10^{-11} . EPA generally characterizes incremental cancer risks in the range of 1×10^{-6} to 1×10^{-4} as acceptable. The cancer risks calculated for future construction workers at this site, based on assumption of reasonable maximum exposure, are well below the range generally considered acceptable by EPA. Table 7-6 summarizes the results for all routes of exposure.

The future construction scenario did not exceed criteria for systemic toxicity. The cumulative hazard index for all routes of exposure was 0.009 for all chemicals, and 0.0001 for non-petroleum-related chemicals. Both of these hazard indices are well below unity. Table 7-6 summarizes these results.

7.4.2 Industrial Scenario

The cumulative excess lifetime cancer risks for the soil pathway for potential future industrial workers was one in one million (1×10^{-6}) for all chemicals, and 4×10^{-8} for non-petroleum-related chemicals. Incremental cancer risks in the range of 1×10^{-6} to 1×10^{-4} are generally characterized as acceptable by the EPA. The cancer risks calculated for future industrial workers at this site, based on assumption of reasonable maximum exposure, fall within the range generally considered acceptable by EPA. When petroleum-related chemicals are excluded the cancer risks calculated for future industrial workers fall well below the range generally considered acceptable by EPA. Table 7-7 summarizes the results for all routes of exposure.

The future industrial scenario also did not exceed criteria for systemic toxicity. The cumulative hazard index for all routes of exposure was 0.2 for all chemicals and only 0.003 for non-petroleum-related chemicals. The greatest estimated hazard was via inhalation of VOCs by workers, but the estimated hazard was still over five times lower than the acceptance criteria of less than or equal to 1.0. Table 7-7 summarizes these results.

7.4.3 Hypothetical Residential Scenario

Both soil and groundwater pathways were evaluated for the hypothetical residential scenario. The lifetime excess cancer risk from exposure to soil for potential future residents was 4×10^{-6} . The majority of this total cancer risk was associated with petroleum-related analytes. The cumulative excess lifetime cancer risk for chemicals that are not related to petroleum was only 1×10^{-7} . The total estimated risk was within the range generally considered acceptable by EPA, and fell below that range for chemicals that are not petroleum-related.

The hypothetical future residential scenario did not exceed the systemic toxicity criteria of less than or equal to 1.0 using reasonable maximum exposure-point concentrations. The cumulative hazard index for future adult residents was 0.02, and the index for children was 0.2. These hazard indices were about the same for chemicals that are not petroleum-related. Table 7-8 summarizes the results.

The cumulative excess lifetime cancer risk for the groundwater pathway for residential exposure was 5×10^{-5} for all chemicals, and 3×10^{-5} for chemicals that are not petroleum-related (Table 7-9). Incremental cancer risks in the range of 1×10^{-6} to 1×10^{-4} are generally characterized as acceptable by the EPA. The cancer risks calculated for this site, which are based on conservative exposure scenarios and assumptions of reasonable maximum exposure, fall within the range generally considered acceptable by EPA. Evaluation of the risk assessment results show that benzene and 1,2-DCA are the risk drivers for groundwater by way of the ingestion route of exposure. Benzene concentrations that were reported were only located in the immediate vicinity of the former gasoline UST while 1,2-DCA had a less localized pattern (see Figure 4-12). Using the groundwater modeling results (leachate for the wet case) for benzene, 1,2-DCA, and TMBs (concentrations estimated at the property boundary) as the EPCs for groundwater results in a decreased estimate of excess cancer cases from 5×10^{-5} to 1×10^{-5} and a small decrease in systemic hazard. Table 7-10 presents these results.

The cumulative hazard index (HI) values for adults and children were 2 and 6, respectively. Approximately half of each hazard index is associated with chemicals that are not petroleum-related. These values exceed unity and indicate that there may be a low potential for adverse systemic effects from ingestion of contaminated groundwater at the source area. It is noted that these HI are based on conservative estimates of reasonable maximum exposure and conservatively assume additive health effects from exposure to COPCs. Table 7-9 presents the results for groundwater exposure.

The exposure point concentration for lead was lower than the 4 ug/L default value used in the Integrated Exposure Uptake Biokinetic model, and lead concentrations in soil were within background concentrations. Lead concentrations in the media of concern indicate that blood-lead levels would meet the 10 ug/deciliter (dL) criteria; therefore, modeling of blood-lead levels was not performed.

7.5 SIGNIFICANCE OF THE HHRA RESULTS

Table 7-11 summarizes the HHRA results. Estimated exposure of humans to the COPCs in soils indicate that future cancer risks and systemic toxicity do not exceed regulatory acceptance criteria for either residential or construction/industrial scenarios. The future scenarios presented in this report were evaluated using conservative upper-bound exposure parameters to ensure that health-protective results would be obtained. It is highly likely that the receptors, exposure pathways, and exposure assumptions used to prepare this HHRA result in an overestimation of exposure and, therefore, risk.

A large portion of the soil samples collected from Phase I and Phase II were collected from locations suspected of being in the most contaminated portion of the site as well as from selected areas around the vicinity of the source area. These data, collected from areas that focused on the areas of contamination, were used in the HHRA to characterize site risks. Collection of samples from contaminated areas results in biased data and significantly increases the probability that exposure point concentrations are overestimated. In addition, chemicals not expected to be present at this site were detected and included in the risk assessment. For example, chloroform was only reported from background monitoring wells upgradient of the former UST source area. It is a breakdown product of 1,2-DCA, but was found only upgradient of all 1,2,-DCA detections.

The exposure point concentrations presented in this assessment produce a model of exposure for individuals that gives equal probability of continuous exposure to mean upper limit

chemical concentrations. This is clearly an over-estimation and over-simplification for several reasons:

- Neither potential future residents nor workers would likely remain located strictly in the vicinity of the vehicle lube rack in durations estimated by this assessment,
- Hydrocarbons, which represent the majority of chemicals detected at this site, would likely undergo significant degradation if exposed to the air and ambient weather conditions.

Analytical results from the Phase I and Phase II sampling effort identified subsurface soils in the 15 to 25 feet bgs depths as the soil strata of greatest contamination. If the subsurface soils were to be moved or mixed in with surface soils as a result of construction activities like re-development or home development, neither workers nor residents could be chronically exposed to the concentrations used to estimate the exposure point concentration (EPC) as degradation of many of the hydrocarbons that are present in the soils would occur with time

Risks were also evaluated for contamination in groundwater. Currently, there are no drinking water wells on the property and only one production well in the area (personal communication with Joe Luera, Region IV RWQCB). This nearest well is located about 3 miles north of the site.

General chemistry results for groundwater indicate that the groundwater in this area may not be potable (i.e., drinkable). For example, chloride concentrations (range of 85 to 790 mg/L) exceeded the secondary recommended MCL of 250 mg/L, sulfate concentrations (range of 169 to 905 mg/L) exceeded the secondary recommended MCL of 250 mg/L, and total dissolved solids (TDS) concentrations (range of 962 to 2730 mg/L) exceeded the secondary recommended MCL of 500 mg/L (Cal EPA 1998).

The conservative assumptions and exposure scenarios used to prepare the HHRA for the NMCRC-LA site likely overestimate the risks and hazards posed by contaminants at this site

possibly by three orders of magnitude. Actual risks and systemic hazards at this site could in fact be minimal. Currently, the site is capped by concrete and asphalt and is being used by the City of Los Angeles Fire Department for training purposes. It is not likely that future uses of this site will change significantly or that this site will be zoned as residential. It is also unlikely that potable groundwater wells would be installed on or in the vicinity of this site. During the two field sampling efforts, the majority of monitoring wells located in the area of concern demonstrated low sustainable yields that could possibly exclude this area as a potential source of municipal and/or domestic water supply.

Based on the current and future uses of this site, it is unlikely that human populations will have a significant point of contact with the contaminants identified in subsurface soils and groundwater. The risks and hazards characterized in this assessment are overestimated but this ensures health protection.

7.6 Cumulative and Comparative Risk

Cumulative risk assessment provides a systematic way of looking at environmental problems that potentially may pose different types and degrees of health risk. Using data from available sources, comparative risk assessments can identify the most significant health problems.

Cumulative risk is a screening tool that produces analytical results based on limited multiple pathway exposure scenarios (i.e., incidental soil/dust ingestion, dermal contact and inhalation). The model uses the following simple formula:

$$\text{Hazard quotient (HQ)} = \text{Site Exposure Point Conc.} \times (\text{SRV HQ} / \text{SRV})$$
$$\text{Site ECR} = \text{Site Exposure Point Concentration} \times (\text{SRV ECR} / \text{SRV})$$

- SRV – Soil Reference Values
- ECR – Excess Cancer Risk

Cumulative risk assessment reviews target end-points that include the gastrointestinal system, kidneys, liver, as well as the central nervous system and immune system.

Tables 7-12 and 7-13 show cumulative risk level impacts and health effects associated with COPCs. The cumulative risk exposure table details the potential effects of acute (short-term) exposure to contamination. This should not be interpreted to mean that long-term exposure has no effect on health, rather long-term exposure to low levels of COPCs have been shown to affect an individual's tolerance of short-term exposure to high concentrations of COPCs.

Comparative and cumulative risk assessments are important tools for helping to prioritize solutions to health problems by distinguishing actual risk from potential exposure. The strength of combining both types of processes lies in the ability to compare and evaluate the effects of two or three COPCs and multiple pathways. By using these two methods in conjunction with one another a more comprehensive view is provided. The new view allows the risk manager to place the proper weight on potential risk considerations in the decision making process (carcinogens vs non carcinogens)

Table 7-1
COPC List For NMCRC-LA, 1999

CAS Number	Analyte Name	EPA Weight-of-Evidence Classification (a)	Petroleum Constituent (b)	Soil	Groundwater
56-55-3	Benz(a)anthracene	B2	X	X	
205-99-2	Benzo(b)fluoranthene	B2	X	X	
191-24-2	Benzo(g,h,i)perylene	D	X	X	
50-32-8	Benzo(a)pyrene	B2	X	X	
117-81-7	Bis(2-ethylhexyl)phthalate	B2		X	
75-15-0	Carbon disulfide	none		X	X
218-01-9	Chrysene	B2	X	X	
84-74-2	Di-n-butylphthalate	D			X
206-44-0	Fluoranthene	B2	X	X	
193-39-5	Indeno(1,2,3-cd)pyrene	B2	X	X	
91-57-6	2-Methylnaphthalene	none	X	X	X
91-20-3	Naphthalene	C	X	X	X
85-01-8	Phenanthrene	D	X	X	
129-00-0	Pyrene	D	X	X	
95-63-6	1,2,4-Trimethylbenzene	none	X	X	X
107-06-2	1,2-Dichloroethane	B2		X	X
108-67-8	1,3,5-Trimethylbenzene	none	X	X	X
78-93-3	2-Butanone (MEK)	D		X	
67-64-1	Acetone	D		X	
71-43-2	Benzene	A	X	X	X
67-66-3	Chloroform	B2			X
100-41-4	Ethylbenzene	D	X	X	X
98-82-8	Isopropylbenzene	none	X	X	X
1330-20-7	M/P-Xylene	D	X	X	X
75-09-2	Methylene Chloride	B2		X	

Table 7-1 (continued)
COPC List For NMCRC-LA, 1999

CAS Number	Analyte Name	EPA Weight-of-Evidence Classification (a)	Petroleum Constituent (b)	Soil	Groundwater
104-51-8	N-butylbenzene	none	X	X	
103-65-1	N-propylbenzene	none	X	X	X
1330-20-7	O-xylene	D	X	X	X
99-87-6	P-isopropyltoluene	none	X	X	X
135-98-8	Sec-butylbenzene	none	X	X	X
98-06-6	Tert-butylbenzene	none	X	X	X
127-18-4	Tetrachloroethene	none		X	X
108-88-3	Toluene	D	X	X	X
1336-36-3	PCB Aroclor 1260	B2		X	
7440-36-0	Antimony	N/A			X
7440-39-3	Barium	D			X
7440-47-3	Chromium	D		X	
7440-48-4	Cobalt	D		X	X
7439-92-1	Lead	B2			X
7439-98-7	Molybdenum	D		X	X
7440-02-0	Nickel	N/A		X	X
7440-62-2	Vanadium	N/A		X	
7440-66-6	Zinc	D			X

Notes:

- CAS = Chemical Abstract Number
- COPCs = Chemicals of potential concern
- NMCRC-LA = Naval and Marine Corps Reserve Center-Los Angeles
- EPA = Environmental Protection Agency
- N/A = Not available
- (a) = Weight of evidence classification rationale presented in Appendix I
- (b) = Identified as a component of petroleum by the TPH Criteria Working Group (TPHCWG 1996)

Table 7-2
Exposure Scenarios

Future Scenario	Exposure Pathway	Exposure Route
Construction	Subsurface Soils	Ingestion
		Inhalation (dust/vapors)
		Dermal Contact
Industrial	Subsurface Soils	Ingestion
		Inhalation (dust/vapors)
		Dermal Contact
Residential	Subsurface Soils	Ingestion
		Inhalation (dust/vapors)
		Dermal Contact
Residential	Ground Water	Ingestion
		Inhalation (vapors)
		Dermal Absorption via Shower

NMCRC-LA = Naval and Marine Corps Reserve Center, Los Angeles

TABLE 7-3
Exposure Assumptions for Future
Construction and Industrial Workers And Residents
NMCRCLA

Ingestion of Soils, Inhalation of particulates, and Dermal Exposure					
IR - Ingestion Rate used for Ingestion of Soil					
Ingestion Rate for Industrial/Construction Workers	50	mg/day	Recommended by EPA Region IX	EPA 1999	
Ingestion Rate for Residents - Adults	100	mg/day	Recommended by EPA Region IX	EPA 1999	
Ingestion Rate for Residents - Children	200	mg/day	Recommended by EPA Region IX	EPA 1999	
SIF - Soil Ingestion Factor Adjusted for Residents - Adults and Children	114	mg-yr/kg-d	Recommended by EPA Region IX	EPA 1999	
IR - Ingestion Rate used for Ingestion of Groundwater					
Ingestion Rate for Residents - Adults	2	l/day	Recommended by EPA Region IX	EPA 1999	
Ingestion Rate for Residents - Children	1	l/day		EPA 1997	
WIF - Groundwater Ingestion Factor Adjusted for Residents - Adults and Children	1.09	l-yr/kg-d			
IhR - Inhalation Rate used for Inhalation of Particulates/Vapors					
Inhalation Rate for Industrial/Construction Workers	20	m3/day	Recommended by EPA Region IX	EPA 1999	
Inhalation Rate for Residents - Adults	20	m3/day	Recommended by EPA Region IX	EPA 1999	
Inhalation Rate for Residents - Children	10	m3/day	Recommended by EPA Region IX	EPA 1999	
IF - Inhalation Factor Adjusted for Residents - Adults and Children	11	m3-yr/kg-d	Recommended by EPA Region IX	EPA 1999	
Hourly Inhalation Rate for Residents - Adults and Children Showering	0.6	m3/hour	Recommended by EPA	EPA 1989	
IhVFS - Soil Volatilization Factor used for Inhalation of Volatile Organics ^(a)					
	Chemical Specific m3/kg				
IhVFW - Water Volatilization Factor used for Inhalation	0.5	l/m3	Recommended by EPA Region IX	EPA 1999	
SCF - Skin Contact Factor for Residents - Adults and Children	361	mg-yr/kg-d	Recommended by EPA Region IX	EPA 1999	
SA - Surface Area used for Dermal Exposure					
Skin Surface Area for Industrial/Construction Workers	3,300	sq cm/day	Recommended by EPA Region IX	EPA 1999	
Skin Surface Area for Residents - Child	2,800	sq cm/day	Recommended by EPA Region IX	EPA 1999	
Skin Surface Area for Residents - Adult	5,700	sq cm/day	Recommended by EPA Region IX	EPA 1999	
SAF - Surface Area for Dermal Exposure Adjusted for Residents surface area for showering	3,074	sq cm-yr/kg-day			
	23,000	sq cm	Recommended by EPA Region IX	EPA 1999	
AF - Adherence Factor used for Dermal Exposure					
Soil-to-Skin Adherence Factor (industrial/construction worker and child)	0.2	mg/sq cm	Recommended by EPA Region IX	EPA 1999	
Soil-to-Skin Adherence Factor (adult)	0.07	mg/sq cm	Recommended by EPA Region IX	EPA 1999	
ABS - Soil Dermal Absorption Values					
SVOCs	13%		Recommended by EPA Region IX	EPA 1999	
VOCs	10%		Recommended by EPA Region IX	EPA 1999	
PCBs	14%		Recommended by EPA Region IX	EPA 1999	
Metals ^(b)	1%				
DPC - Dermal Permeability Constant					
Organics	Chemical Specific cm/hr				
Inorganics	1.00E-03	cm/hr			
CF - Conversion Factor					
Conversion Factor	1.00E-06	kg/mg	Recommended by EPA	EPA 1989	
Conversion Factor	1.00E-03	l/cu cm			
EF - Exposure Frequency					
Exposure Frequency for Construction Workers	14	days/year	Estimated		
Exposure Frequency for Industrial Workers	250	days/year	Recommended by EPA Region IX	EPA 1999	
Exposure Frequency for Residents - Adults and Children	350	days/year	Recommended by EPA Region IX	EPA 1999	
ED - Exposure Duration					
Exposure Duration for Construction Workers	1	year	Estimated		
Exposure Duration for Industrial/Commercial Workers	25	years	Recommended by EPA	EPA 1993	
Exposure Duration for Residents - Adults	24	years	Recommended by EPA Region IX	EPA 1999	
Exposure Duration for Residents - Children	6	years	Recommended by EPA Region IX	EPA 1999	
BW - Body Weight					
Body Weight for Industrial/Construction Workers	70	kg	Recommended by EPA Region IX	EPA 1999	
Body Weight for Residents - Adults	70	kg	Recommended by EPA Region IX	EPA 1999	
Body Weight for Residents - Children	15	kg	Recommended by EPA Region IX	EPA 1999	
AT - Averaging Time ^(c)					
Carcinogens	25,550	days	Recommended by EPA	EPA 1989	
Noncarcinogens - Construction Workers	365	days	Recommended by EPA	EPA 1989	
Noncarcinogens - Industrial Workers	9,125	days	Recommended by EPA	EPA 1989	
Noncarcinogens - Residents	10,950	days			
Noncarcinogens - Residents - Adults	8,760	days			
Noncarcinogens - Residents - Children	2,190	days	Recommended by EPA	EPA 1989	
PEF - Particulate Emission Factor					
Particulate Emission Factor - Construction Activities	6.67E+06	cu m/kg	CDM Federal Programs		
Particulate Emission Factor - Typical Activities	1.32E+09	cu m/kg	Recommended by EPA Region IX	EPA 1999	
FI - Fraction of Soil Ingested from Site					
Fraction of Soil Ingested from Site - All Receptors	100%		DTSC		
Exposure time for showering	0.583	h/d	Recommended by EPA	EPA 1997	

Notes:

(a)= Chemicals having a Henry's Law Constant greater than 10⁻⁵ and a molecular weight less than 200 grams per mole

" " = All COPC metals

AT, carcinogenic = 70 years * 365 days/year = 25550 days. AT, noncarcinogenic = Exposure Duration * 365 days/year

NMCRCLA = Naval and Marine Corps Reserve Center - Los Angeles

DTSC = Department of Toxic Substances Control

mg = milligrams, kg=kilogram cm=centimeter, mg-yr = milligram-year, kg-d = kilogram-day m3= cubic meters = sq cm = square centimeter

sq cm-yr = square centimeter-year cu cm=cubic centimeter h/d= hours per day

Table 7-4
Summary Statistics for COPCs in Subsurface Soils
NMCRC-LA, 1999-2000

Analyte	Number of Samples	Detection Frequency	Minimum Reported Concentration	Maximum Reported Concentration	Arithmetic Mean	Standard Deviation ^(b)	95% UCL ^(c)	Exposure Point Concentration ^(d)
SVOCs (µg/kg)								
Benz(a)anthracene	50	2%	140	140	5.66	0.11	293.77	140.00
Benzo(a)pyrene	50	4%	56	180	5.63	0.24	298.20	180.00
Benzo(b)fluoranthene	50	4%	57	290	5.67	0.28	313.75	290.00
Benzo(g,h,i)perylene	50	2%	82	82	5.82	0.36	377.68	82.00
Chrysene	50	4%	85	220	6.01	0.43	472.05	220.00
Fluoranthene	50	4%	110	300	5.66	0.14	295.06	295.06
Indeno(1,2,3-cd)pyrene	50	2%	82	82	5.82	0.36	377.68	82.00
2-Methylnaphthalene	50	16%	265	3100	5.83	0.45	401.48	401.48
Napthalene	50	18%	70	7300	5.88	0.69	502.28	502.28
Phenanthrene	50	4%	72	200	5.64	0.21	296.21	200.00
Pyrene	50	4%	150	370	5.83	0.32	376.54	370.00
VOCs (µg/kg)								
1,2,4-Trimethylbenzene	50	28%	1	40500	2.82	3.37	8018.89	8018.89
1,2-Dichloroethane	50	18%	1	12	1.25	0.93	6.12	6.12
1,3,5-Trimethylbenzene	50	22%	1	27200	2.43	2.83	930.16	930.16
2-Butanone (MEK)	50	30%	4	129	3.55	1.14	78.71	78.71
Acetone	50	40%	7	290	4.28	0.82	113.40	113.40
Benzene	50	16%	1	698	1.47	1.22	10.97	10.97
Carbon disulfide	50	10%	1	36	1.32	1.04	7.43	7.43
Ethylbenzene	50	32%	1	9810	2.29	2.60	426.72	426.72
Isopropylbenzene (cumene)	50	28%	2	1580	2.00	1.93	62.78	62.78
M/P-Xylene	50	20%	1	35000	2.24	2.83	774.28	774.28
Methylene Chloride	50	10%	3	54	2.11	1.43	27.97	27.97
Napthalene	50	28%	3	4760	2.33	2.51	345.21	345.21
N-Butylbenzene	50	2%	3	4	1.10	0.15	3.11	3.11
N-Propylbenzene	50	10%	3	960	1.32	1.05	7.56	7.56
O-Xylene	50	14%	3	12600	1.96	2.30	138.51	138.51
P-Isopropyltoluene	50	22%	3	891	1.92	1.73	39.05	39.05
Sec-Butylbenzene	50	24%	1	831	1.77	1.68	30.40	30.40
Tert-Butylbenzene	50	2%	3	2370	1.25	0.96	6.30	6.30
Tetrachloroethene	50	2%	1	1	1.07	0.21	3.56	1.00
Toluene	50	14%	3	5620	1.75	1.80	37.80	37.80
PCBs (µg/kg)								
Aroclor 1260	50	8%	14	21	3.07	0.35	24.06	21.00
Metals (mg/kg)								
Chromium	19	100%	5	37	21.93(e)	5.34(e)	23.11(e)	23.11
Cobalt	19	100%	3	24	10.91(e)	3.21(e)	17.23(e)	23.80
Molybdenum	19	84%	0	6	0.21	0.95	1.16	1.16
Nickel	19	100%	6	39	25.98(e)	7.11(e)	27.55(e)	27.55
Vanadium	19	100%	8	79	52.12(e)	13.72(e)	79.08(e)	79.30

(a) = Includes field QC duplicate samples

(b) = Standard deviation of (natural) log transformed data

(c) = 95% upper confidence limit of the arithmetic mean for lognormal distribution of data

(d) = Exposure point concentration is the lower of either the maximum or 95% UCL of mean value

(e) = Calculated results based on a normal distribution per background statistical results

NMCRC-LA = Naval and Marine Corps Reserve Center - Los Angeles

COPC = Chemical of potential concern

PCBs = Polychlorinated biphenyls

SVOCs = Semivolatile organic compounds

VOCs = Volatile Organic Compounds

UCL = Upper Confidence Limit

mg/kg = milligram per kilogram

µg/kg = microgram per kilogram

Table 7-5
Summary Statistics for COPCs in Groundwater
NMCRC-LA, 1999-2000

Analyte	Number of Samples ^(a)	Detection Frequency	Minimum Detected Concentration (µg/l)	Maximum Detected Concentration (µg/l)	Arithmetic Mean (µg/l)	Lognormal Standard Deviation (µg/l)	95% UCL	Exposure Point Concentration (µg/l)
SVOCs								
DI-N-BUTYL PHTHALATE	16	6.3%	19	19	6.59	0.52	8.71	8.71
2-METHYLNAPHTHALENE	16	25.0%	5	26	8.44	0.54	11.07	11.07
NAPHTHALENE	16	18.8%	19	76	14.94	0.91	23.75	23.75
VOCs								
1,2,4-TRIMETHYLBENZENE	19	47.4%	1	1130	65.50	1.60	74.22	74.22
1,2-DICHLOROETHANE	19	68.4%	1	28	7.66	0.96	13.32	13.32
1,3,5-TRIMETHYLBENZENE	19	36.8%	3	320	20.58	1.13	18.23	18.23
BENZENE	19	42.1%	1	588	35.95	1.37	37.79	37.79
CARBON DISULFIDE	19	5.3%	1	1	2.55	0.27	2.88	1.00
CHLOROFORM	19	36.8%	1	10	2.68	0.73	4.03	4.03
ETHYLBENZENE	19	26.3%	2	711	40.32	1.31	22.59	22.59
ISOPROPYLBENZENE	19	52.6%	1	54	5.24	0.98	7.35	7.35
M/P-XYLENE	19	15.8%	3	1590	86.79	1.47	40.98	40.98
NAPHTHALENE	19	36.8%	1	120	10.06	1.11	13.12	13.12
N-PROPYLBENZENE	19	26.3%	1	304	19.16	1.26	18.23	18.23
O-XYLENE	19	5.3%	528	528	30.29	1.23	17.41	17.41
P-ISOPROPYLTOLUENE	19	21.1%	0	10	2.81	0.61	3.87	3.87
SEC-BUTYLBENZENE	19	36.8%	1	12	2.80	0.72	4.09	4.09
TERT-BUTYLBENZENE	19	26.3%	1	1	2.01	0.65	2.96	1.00
TETRACHLOROETHENE	19	15.8%	1	2	2.37	0.22	2.61	2.00
OLUENE	19	15.8%	1	313	18.89	1.27	15.97	15.97
METALS (Filtered)								
Barium	19	100.0%	15	445	97.62	1.06	176.94	176.94
Cobalt	19	26.0%	1	30	5.52	0.93	8.86	8.86
Lead	19	11.0%	7	17	3.87	0.50	1.44	1.44
Nickel	19	74.0%	3	41	9.93	0.89	16.53	16.53
Molybdenum	19	95.0%	17	344	53.25	0.92	92.42	92.42
Antimony	19	37.0%	3	11	5.13	0.28	5.80	5.80
Zinc	19	95.0%	7	25	14.05	0.55	19.01	19.01

Notes:

(a) = Includes field QC duplicate samples

95% UCL = 95% upper confidence limit of the arithmetic mean

Sample results qualified as "U", not-detected, were used in the statistical calculations at 1/2 the reported limit of detection

Sample results qualified as "UJ" estimated non-detected were used in the statistical calculations at the reported limit of detection

NMCRC-LA = Naval and Marine Corps Reserve Center - Los Angeles

UCL = Upper Confidence Limit

VOCs = Volatile Organic Compounds

SVOCs = Semivolatile organic compounds

COPC = Chemical of potential concern

mg/L = milligram per liter

µg/L = microgram per liter

TABLE 7-6
Future Construction Worker Scenario
Cancer Risks and Toxicity Hazard from Subsurface Soil Exposure
NMCRC-1A

CHEMICAL	Exposure Point Concentration (mg/kg)	Cancer Risk based on EPA & CA CSF	Hazard based on EPA RfD
SOIL INGESTION ROUTE			
SVOCs			
* BENZ(A)ANTHRACENE	1 40E-01	4 00E-11	1 92E-07
* Benzo(a)pyrene	1 80E-01	6 34E-10	2 47E-07
* BENZO(B)FLUORANTHENE	2 90E-01	8 29E-11	3 97E-07
* BENZO(G,H,I)PERYLENE	8 20E-02	NC	1 12E-07
* CHRYSENE	2 20E-01	7 75E-12	3 01E-07
* FLUORANTHENE	2 95E-01	NC	4 04E-07
* INDENO(1 2,3-CD)PYRENE	8 20E-02	2 34E-11	1 12E-07
* 2-METHYLNAPHTHALENE	4 01E-01	NC	5 50E-07
* NAPHTHALENE	5 02E-01	NC	6 88E-07
* PHENANTHRENE	2 00E-01	NC	2 74E-07
* PYRENE	3 70E-01	NC	3 38E-07
CHEMICAL CLASS-SPECIFIC RISK =		7 88E-10	3 62E-06
VOCs			
* 1 2 4-TRIMETHYLBENZENE	8 02E+00	none	3 14E-07
1,2-DICHLOROETHANE	6 12E-03	2 18E-13	7 98E-11
* 1 3 5-TRIMETHYLBENZENE	9 30E-01	none	3 64E-08
2-BUTANONE (MEK)	7 87E-02	NC	5 13E-11
ACETONE	1 13E-01	NC	4 44E-10
* BENZENE	1 10E-02	6 44E-14	1 43E-09
Carbon disulfide	7 43E-03	none	2 91E-11
* ETHYLBENZENE	4 27E-01	NC	1 67E-09
* ISOPROPYLBENZENE	6 28E-02	none	2 46E-09
* M/P-XYLENE	7 74E-01	NC	1 52E-10
METHYLENE CHLORIDE	2 80E-02	8 21E-14	1 82E-10
* NAPHTHALENE	3 45E-01	NC	6 76E-09
* N-BUTYLBENZENE	3 11E-03	none	1 22E-10
* N-PROPYLBENZENE	7 56E-03	none	2 96E-10
* O-XYLENE	1 39E-01	NC	2 71E-11
* P-ISOPROPYLTOLUENE	3 91E-02	none	7 64E-11
* SEC-BUTYLBENZENE	3 04E-02	none	1 19E-09
* TERT-BUTYLBENZENE	6 30E-03	none	2 47E-10
TETRACHLOROETHENE	1 00E-03	none	3 91E-11
* TOLUENE	3 78E-02	NC	7 40E-11
CHEMICAL CLASS-SPECIFIC RISK =		3 64E-13	3 66E-07
PCBs			
AROCLOR 1260	2 10E-02	1 64E-11	4 11E-07
CHEMICAL CLASS-SPECIFIC RISK =		1 64E-11	4 11E-07
METALS			
Chromium	2 31E+01	NA	6 03E-09
Cobalt	2 38E+01	NA	1 55E-07
Molybdenum	1 16E+00	none	9 08E-08
Nickel	2 76E+01	NA	none
Vanadium	7 93E+01	NA	4 43E-06
CHEMICAL CLASS-SPECIFIC RISK =		0 00E+00	4 69E-06
PATHWAY-SPECIFIC RISK =			
PATHWAY-SPECIFIC RISK (Petroleum) =		8 05E-10	9 08E-06
PATHWAY-SPECIFIC RISK (CERCLA-only) =		7 88E-10	3 98E-06
		1 67E-11	5 10E-06
INHALATION ROUTE - Particulates^c/ Vapors^d			
SVOCs^c			
* BENZ(A)ANTHRACENE	1 40E-01	2 40E-12	1 15E-08
* Benzo(a)pyrene	1 80E-01	3 80E-11	1 48E-08
* BENZO(B)FLUORANTHENE	2 90E-01	4 97E-12	2 38E-08
* BENZO(G,H,I)PERYLENE	8 20E-02	NC	6 74E-09
* CHRYSENE	2 20E-01	4 65E-13	1 81E-08
* FLUORANTHENE	2 95E-01	NC	2 42E-08
* INDENO(1 2,3-CD)PYRENE	8 20E-02	1 41E-12	6 74E-09
* 2-METHYLNAPHTHALENE	4 01E-01	NC	3 30E-08
* NAPHTHALENE	5 02E-01	NC	4 13E-08
* PHENANTHRENE	2 00E-01	NC	1 64E-08

TABLE 7-6
Future Construction Worker Scenario
Cancer Risks and Toxicity Hazard from Subsurface Soil Exposure
NMCRC-1A

CHEMICAL	Exposure Point Concentration (mg/kg)	Cancer Risk based on EPA & CA CSF	Hazard based on EPA RfD
* PYRENE	3.70E-01	NC	2.03E-08
CHEMICAL CLASS-SPECIFIC RISK = VOCs ^d		4.73E-11	2.17E-07
* 1,2,4-TRIMETHYLBENZENE	8.02E+00	none	7.74E-03
1,2-DICHLOROETHANE	6.12E-03	2.31E-11	5.94E-07
* 1,3,5-TRIMETHYLBENZENE	9.30E-01	none	1.09E-03
2-BUTANONE (MEK)	7.87E-02	NC	7.57E-08
ACETONE	1.13E-01	NC	1.60E-06
* BENZENE	1.10E-02	2.69E-11	4.18E-05
Carbon disulfide	7.43E-03	none	8.78E-07
* ETHYLBENZENE	4.27E-01	NC	5.04E-05
* ISOPROPYLBENZENE	6.28E-02	none	3.91E-06
* M/P-XYLENE	7.74E-01	NC	4.75E-07
METHYLENE CHLORIDE	2.80E-02	2.06E-11	3.21E-06
* NAPHTHALENE	3.45E-01	NC	6.72E-06
* N-BUTYLBENZENE	3.11E-03	none	2.27E-08
* N-PROPYLBENZENE	7.56E-03	none	5.52E-08
* O-XYLENE	1.39E-01	NC	8.50E-08
* P-ISOPROPYLTOLUENE	3.91E-02	none	3.38E-08
* SEC-BUTYLBENZENE	3.04E-02	none	4.50E-05
* TERT-BUTYLBENZENE	6.30E-03	none	8.56E-06
TETRACHLOROETHENE	1.00E-03	none	3.42E-07
* TOLUENE	3.78E-02	NC	5.75E-07
CHEMICAL CLASS-SPECIFIC RISK = PCBs ^e		7.06E-11	8.99E-03
AROCLOR 1260	2.10E-02	9.86E-13	1.73E-06
CHEMICAL CLASS-SPECIFIC RISK = METALS ^f		9.86E-13	1.73E-06
Chromium	2.31E+01	NA	2.53E-08
Cobalt	2.38E+01	NA	6.52E-07
Molybdenum	1.16E+00	none	3.81E-07
Nickel	2.76E+01	NA	none
Vanadium	7.93E+01	NA	1.86E-05
CHEMICAL CLASS-SPECIFIC RISK =		0.00E+00	1.97E-05
PA THWAY-SPECIFIC RISK =		1.19E-10	9.02E-03
PA THWAY-SPECIFIC RISK (Petroleum) =		7.41E-11	8.99E-03
PA THWAY-SPECIFIC RISK (CERCLA-only) =		4.47E-11	2.81E-05
DERMAL ROUTE			
SVOCs			
* BENZ(A)ANTHRACENE	1.40E-01	6.86E-11	3.29E-07
* Benzo(a)pyrene	1.80E-01	1.09E-09	4.23E-07
* BENZO(B)FLUORANTHENE	2.90E-01	1.42E-10	6.82E-07
* BENZO(G,H,I)PERYLENE	8.20E-02	NC	1.93E-07
* CHRYSENE	2.20E-01	1.33E-11	5.17E-07
* FLUORANTHENE	2.95E-01	NC	6.94E-07
* INDENO(1,2,3-CD)PYRENE	8.20E-02	4.02E-11	1.93E-07
* 2-METHYLNAPHTHALENE	4.01E-01	none	9.44E-07
* NAPHTHALENE	5.02E-01	NC	1.18E-06
* PHENANTHRENE	2.00E-01	NC	4.70E-07
* PYRENE	3.70E-01	NC	5.80E-07
CHEMICAL CLASS-SPECIFIC RISK = VOCs		1.35E-09	6.20E-06
* 1,2,4-TRIMETHYLBENZENE	8.02E+00	none	2.90E-05
1,2-DICHLOROETHANE	6.12E-03	2.88E-13	7.38E-09
* 1,3,5-TRIMETHYLBENZENE	9.30E-01	none	3.36E-06
2-BUTANONE (MEK)	7.87E-02	NC	4.74E-09
ACETONE	1.13E-01	NC	4.10E-08
* BENZENE	1.10E-02	8.50E-14	1.32E-07
Carbon disulfide	7.43E-03	none	2.69E-09
* ETHYLBENZENE	4.27E-01	NC	1.54E-07
* ISOPROPYLBENZENE	6.28E-02	none	2.27E-07
* M/P-XYLENE	7.74E-01	NC	1.40E-08
METHYLENE CHLORIDE	2.80E-02	1.08E-13	1.69E-08
* NAPHTHALENE	3.45E-01	NC	6.24E-07
* N-BUTYLBENZENE	3.11E-03	none	1.13E-08

TABLE 7-6
Future Construction Worker Scenario
Cancer Risks and Toxicity Hazard from Subsurface Soil Exposure
NMCRC-LA

CHEMICAL	Exposure Point Concentration (mg/kg)	Cancer Risk based on EPA & CA CSF	Hazard based on EPA RfD
* N-PROPYLBENZENE	7.56E-03	none	2.74E-08
* O-XYLENE	1.39E-01	NC	2.50E-09
* P-ISOPROPYLTOLUENE	3.91E-02	none	7.06E-09
* SEC-BUTYLBENZENE	3.04E-02	none	1.10E-07
* TERT-BUTYLBENZENE	6.30E-03	none	2.28E-08
1,1,2,2-TETRACHLOROETHENE	1.00E-03	none	3.62E-09
* TOLUENE	3.78E-02	NC	6.83E-09
CHEMICAL CLASS-SPECIFIC RISK = PCBs		4.81E-13	3.38E-05
AROCOLOR 1260	2.10E-02	3.04E-11	5.32E-05
CHEMICAL CLASS-SPECIFIC RISK = METALS		3.04E-11	5.32E-05
Chromium	2.31E+01	NA	5.57E-08
Cobalt	2.38E+01	NA	1.43E-06
Molybdenum	1.16E+00	none	8.39E-07
Nickel	2.76E+01	NA	none
Vanadium	7.93E+01	NA	4.10E-05
CHEMICAL CLASS-SPECIFIC RISK =		0.00E+00	4.33E-05
PATHWAY-SPECIFIC RISK =		1.38E-09	1.36E-04
PATHWAY-SPECIFIC RISK (Petroleum) =		1.35E-09	3.99E-05
PATHWAY-SPECIFIC RISK (CERCLA-only) =		3.08E-11	9.65E-05
TOTAL:			
		2.31E-09	9.16E-03
Petroleum-related:		2.21E-09	9.03E-03
CERCLA-only:		9.23E-11	1.30E-04

* = Petroleum-related chemical

CPF = Cancer Potency Factor

CDI = chronic daily intake

mg/kg-day = milligrams per kilogram per day

EPC = Exposure Point Concentration

NA = Not Available

NC = Not a known carcinogen

NMCRC-LA = Naval and Marine Corps Reserve Center- Los Angeles

RfD = Reference Dose

a = No RfD located. Surrogate toxicity value used based on structure relationship

b = Surrogate toxicity value used based on EPA Region IX PRG Table October 1999

c = Chemicals having a Henry's Law Constant below 10^{-5} and a molecular weight greater than 200 g/mol

d = Chemicals having a Henry's Law Constant greater than 10^{-5} and a molecular weight less than 200 g/mol

e = Toxicity criteria from EPA Region IX Preliminary Remediation Goals 1999

f = If a CPF was available from the U.S. EPA but not from the California EPA, the EPA CPF was used in California EPA calculations

TABLE 7-7
Future Industrial Worker Scenario
Cancer Risks and Toxicity Hazard from Subsurface Soil Exposure
NMCRC-1A

CHEMICAL	Exposure Point Concentration (mg/kg)	Cancer Risk based on EPA & CA CSF	Hazard based on EPA RfD
SOIL INGESTION ROUTE			
SVOCs			
* BENZ(A)ANTHRACENE	1 40E-01	1 79E-08	3 42E-06
* Benzo(a)pyrene	1 80E-01	2 83E-07	4 40E-06
* BENZO(B)FLUORANTHENE	2 90E-01	3 70E-08	7 09E-06
* BENZO(G,H,I)PERYLENE	8 20E-02	NC	2 01E-06
* CHRYSENE	2 20E-01	3 46E-09	5 38E-06
* FLUORANTHENE	2 95E-01	NC	7 22E-06
* INDENO(1,2,3-CD)PYRENE	8 20E-02	1 05E-08	2 01E-06
* 2-METHYLNAPHTHALENE	4 01E-01	NC	9 82E-06
* NAPHTHALENE	5 02E-01	NC	1 23E-05
* PHENANTHRENE	2 00E-01	NC	4 89E-06
* PYRENE	3 70E-01	NC	6 03E-06
CHEMICAL CLASS-SPECIFIC RISK =		3 52E-07	6 46E-05
VOCs			
* 1,2,4-TRIMETHYLBENZENE	8 02E+00	none	1 40E-04
1,2-DICHLOROETHANE	6 12E-03	9 73E-11	3 56E-08
* 1,3,5-TRIMETHYLBENZENE	9 30E-01	none	1 63E-05
2-BUTANONE (MEK)	7 87E-02	NC	2 29E-08
ACETONE	1 13E-01	NC	1 98E-07
* BENZENE	1 10E-02	2 88E-11	6 39E-07
Carbon disulfide	7 43E-03	none	1 30E-08
* ETHYLBENZENE	4 27E-01	NC	7 46E-07
* ISOPROPYLBENZENE	6 28E-02	none	1 10E-06
* M/P-XYLENE	7 74E-01	NC	6 76E-08
METHYLENE CHLORIDE	2 80E-02	3 66E-11	8 14E-08
* NAPHTHALENE	3 45E-01	NC	3 02E-06
* N-BUTYLBENZENE	3 11E-03	none	5 44E-08
* N-PROPYLBENZENE	7 56E-03	none	1 32E-07
* O-XYLENE	1 39E-01	NC	1 21E-08
* P-ISOPROPYLTOLUENE	3 91E-02	none	3 41E-08
* SEC-BUTYLBENZENE	3 04E-02	none	5 31E-07
* TERT-BUTYLBENZENE	6 30E-03	none	1 10E-07
TETRACHLOROETHENE	1 00E-03	none	1 75E-08
* TOLUENE	3 78E-02	NC	3 30E-08
CHEMICAL CLASS-SPECIFIC RISK =		1 63E-10	1 63E-04
PCBs			
AROCLOR 1260	2 10E-02	7 34E-09	1 83E-04
CHEMICAL CLASS-SPECIFIC RISK =		7 34E-09	1 83E-04
METALS			
Chromium	2 31E+01	NA	2 69E-06
Cobalt	2 38E+01	NA	6 93E-05
Molybdenum	1 16E+00	none	4 05E-05
Nickel	2 76E+01	NA	none
Vanadium	7 93E+01	NA	1 98E-03
CHEMICAL CLASS-SPECIFIC RISK =		0 00E+00	2 09E-03
PATHWAY-SPECIFIC RISK =			
PATHWAY-SPECIFIC RISK (Petroleum) =		3 59E-07	2 50E-03
PATHWAY-SPECIFIC RISK (CERCLA-only) =		3 52E-07	2 27E-04
		7 47E-09	2 28E-03
INHALATION ROUTE - Particulates^c/ Vapors^d			
SVOCs^c			
* BENZ(A)ANTHRACENE	1 40E-01	5 43E-12	1 04E-09
* Benzo(a)pyrene	1 80E-01	8 60E-11	1 34E-09
* BENZO(B)FLUORANTHENE	2 90E-01	1 12E-11	2 16E-09
* BENZO(G,H,I)PERYLENE	8 20E-02	NC	6 10E-10
* CHRYSENE	2 20E-01	2 94E-12	1 64E-09
* FLUORANTHENE	2 95E-01	NC	2 19E-09
* INDENO(1,2,3-CD)PYRENE	8 20E-02	3 18E-12	6 10E-10
* 2-METHYLNAPHTHALENE	4 01E-01	NC	2 99E-09
* NAPHTHALENE	5 02E-01	NC	3 73E-09
* PHENANTHRENE	2 00E-01	NC	1 49E-09
* PYRENE	3 70E-01	NC	1 83E-09
CHEMICAL CLASS-SPECIFIC RISK =		1 09E-10	1 96E-08
VOCs^d			

TABLE 7-7
Future Industrial Worker Scenario
Cancer Risks and Toxicity Hazard from Subsurface Soil Exposure
NMCRCL-A

CHEMICAL	Exposure Point Concentration (mg/kg)	Cancer Risk based on EPA & CA CSF	Hazard based on EPA RfD
* 1,2,4-TRIMETHYLBENZENE	8.02E+00	none	1.38E-01
1,2-DICHLOROETHANE	6.12E-03	1.03E-08	1.06E-05
* 1,3,5-TRIMETHYLBENZENE	9.30E-01	none	1.95E-02
2-BUTANONE (MEK)	7.87E-02	NC	1.35E-06
ACETONE	1.13E-01	NC	2.86E-05
* BENZENE	1.10E-02	1.20E-08	7.46E-04
Carbon disulfide	7.43E-03	none	1.57E-05
* ETHYLBENZENE	4.27E-01	NC	9.00E-04
* ISOPROPYLBENZENE	6.28E-02	none	6.99E-05
* M/P-XYLENE	7.74E-01	NC	8.49E-06
METHYLENE CHLORIDE	2.80E-02	9.20E-09	5.72E-05
* NAPHTHALENE	3.45E-01	NC	1.20E-04
* N-BUTYLBENZENE	3.11E-03	none	4.06E-07
* N-PROPYLBENZENE	7.56E-03	none	9.85E-07
* O-XYLENE	1.39E-01	NC	1.52E-06
* P-ISOPROPYLTOLUENE	3.91E-02	none	6.03E-07
* SEC-BUTYLBENZENE	3.04E-02	none	8.04E-04
* TERT-BUTYLBENZENE	6.30E-03	none	1.53E-04
TETRACHLOROETHENE	1.00E-03	none	6.12E-06
* TOLUENE	3.78E-02	NC	1.03E-05
CHEMICAL CLASS-SPECIFIC RISK =		3.15E-08	1.61E-01
PCBs ^c			
AROCLOR 1260	2.10E-02	6.25E-12	1.56E-07
CHEMICAL CLASS-SPECIFIC RISK =		6.25E-12	1.56E-07
METALS ^c			
Chromium	2.31E+01	NA	2.29E-09
Cobalt	2.38E+01	NA	5.90E-08
Molybdenum	1.16E+00	none	3.45E-08
Nickel	2.76E+01	NA	none
Vanadium	7.93E+01	NA	1.68E-06
CHEMICAL CLASS-SPECIFIC RISK =		0.00E+00	1.78E-06
PATHWAY-SPECIFIC RISK =		3.16E-08	1.61E-01
PATHWAY-SPECIFIC RISK (Petroleum) =		1.21E-08	1.60E-01
PATHWAY-SPECIFIC RISK (CERCLA-only) =		1.95E-08	1.22E-04
DERMAL ROUTE			
SVOCs			
* BENZ(A)ANTHRACENE	1.40E-01	3.06E-08	5.88E-06
* Benzo(a)pyrene	1.80E-01	4.86E-07	7.56E-06
* BENZO(B)FLUORANTHENE	2.90E-01	6.35E-08	1.22E-05
* BENZO(G,H,I)PERYLENE	8.20E-02	NC	3.44E-06
* CHRYSENE	2.20E-01	5.94E-09	9.23E-06
* FLUORANTHENE	2.95E-01	NC	1.24E-05
* INDENO(1,2,3-CD)PYRENE	8.20E-02	1.79E-08	3.44E-06
* 2-METHYLNAPHTHALENE	4.01E-01	none	1.69E-05
* NAPHTHALENE	5.02E-01	NC	2.11E-05
* PHENANTHRENE	2.00E-01	NC	8.40E-06
* PYRENE	3.70E-01	NC	1.04E-05
CHEMICAL CLASS-SPECIFIC RISK =		6.04E-07	1.11E-04
VOCs			
* 1,2,4-TRIMETHYLBENZENE	8.02E+00	none	5.18E-04
1,2-DICHLOROETHANE	6.12E-03	1.28E-10	1.32E-07
* 1,3,5-TRIMETHYLBENZENE	9.30E-01	none	6.01E-05
2-BUTANONE (MEK)	7.87E-02	NC	8.47E-08
ACETONE	1.13E-01	NC	7.32E-07
* BENZENE	1.10E-02	3.80E-11	2.36E-06
Carbon disulfide	7.43E-03	none	4.80E-08
* ETHYLBENZENE	4.27E-01	NC	2.76E-06
* ISOPROPYLBENZENE	6.28E-02	none	4.05E-06
* M/P-XYLENE	7.74E-01	NC	2.50E-07
METHYLENE CHLORIDE	2.80E-02	4.84E-11	3.01E-07
* NAPHTHALENE	3.45E-01	NC	1.11E-05
* N-BUTYLBENZENE	3.11E-03	none	2.01E-07
* N-PROPYLBENZENE	7.56E-03	none	4.88E-07
* O-XYLENE	1.39E-01	NC	4.47E-08
* P-ISOPROPYLTOLUENE	3.91E-02	none	1.26E-07
* SEC-BUTYLBENZENE	3.04E-02	none	1.96E-06
* TERT-BUTYLBENZENE	6.30E-03	none	4.07E-07
TETRACHLOROETHENE	1.00E-03	none	6.46E-08

TABLE 7-7
Future Industrial Worker Scenario
Cancer Risks and Toxicity Hazard from Subsurface Soil Exposure
NMCRC-LA

CHEMICAL	Exposure Point Concentration (mg/kg)	Cancer Risk based on EPA & CA CSF	Hazard based on EPA RfD
* TOLUENE	3.78E-02	NC	1.22E-07
CHEMICAL CLASS-SPECIFIC RISK =		2.15E-10	6.03E-04
PCBs			
AROCLOR 1260	2.10E-02	1.36E-08	3.39E-04
CHEMICAL CLASS-SPECIFIC RISK =		1.36E-08	3.39E-04
METALS			
Chromium	2.31E+01	NA	3.55E-07
Cobalt	2.38E+01	NA	9.15E-06
Molybdenum	1.16E+00	none	5.55E-06
Nickel	2.76E+01	NA	none
Vanadium	7.93E+01	NA	2.61E-04
CHEMICAL CLASS-SPECIFIC RISK =		0.00E+00	2.76E-04
PATHWAY-SPECIFIC RISK =		6.18E-07	1.33E-03
PATHWAY-SPECIFIC RISK (Petroleum) =		6.04E-07	7.13E-04
PATHWAY-SPECIFIC RISK (CERCLA-only) =		1.37E-08	6.17E-04
TOTAL:		1.01E-06	1.64E-01
Petroleum-related:		9.68E-07	1.61E-01
CERCLA-only:		4.07E-08	3.01E-03

* = Petroleum-related chemical

CPF = Cancer Potency Factor

CDI = chronic daily intake

mg/kg-day = milligrams per kilogram per day

EPC = Exposure Point Concentration

NA = Not Available

NC = Not a known carcinogen

NMCRC-LA = Naval and Marine Corps Reserve Center- Los Angeles

RfD = Reference Dose

a = No RfD located. Surrogate toxicity value used based on structure relationship

b = Surrogate toxicity value used based on EPA Region IX PRG Table 1999

c = Chemicals having a Henry's Law Constant below 10^{-5} and a molecular weight greater than 100

d = Chemicals having a Henry's Law Constant greater than 10^{-5} and a molecular weight less than 100

e = Toxicity criteria from EPA Region 9 Preliminary Remediation Goals 1999

f = If a CPF was available from the U.S. EPA but not from the California EPA, the EPA CPF was used in the California EPA calculations

TABLE 7-8
FUTURE RESIDENTIAL SCENARIO FOR ADULT AND CHILD
CANCER RISKS AND TOXICITY HAZARD FROM SUBSURFACE SOIL EXPOSURE
NMCRC-LA

CHEMICAL	EPC (mg/kg)	Cancer Risk based on EPA & CA CSF	Adult Hazard based on EPA RfD	Child Hazard based on EPA RfD
SOIL INGESTION ROUTE				
SVOCs				
* BENZ(A)ANTHRACENE	1.40E-01	1.60E-07	9.59E-06	8.95E-05
* Benzo(a)Pyrene	1.80E-01	2.53E-06	1.23E-05	1.15E-04
* BENZO(B)FLUORANTHENE	2.90E-01	3.31E-07	1.99E-05	1.85E-04
* BENZO(G,H,I)PERYLENE	8.20E-02	NC	5.62E-06	5.24E-05
* CHRYSENE	2.20E-01	3.09E-08	1.51E-05	1.41E-04
* FLUORANTHENE	2.95E-01	NC	2.02E-05	1.89E-04
* INDENO(1,2,3-CD)PYRENE	8.20E-02	9.35E-08	5.62E-06	5.24E-05
* 2-METHYLNAPHTHALENE	4.01E-01	none	2.75E-05	2.57E-04
* NAPHTHALENE	5.02E-01	NC	3.44E-05	3.21E-04
* PHENANTHRENE	2.00E-01	NC	1.37E-05	1.28E-04
* PYRENE	3.70E-01	NC	1.69E-05	1.58E-04
CHEMICAL CLASS-SPECIFIC RISK =		3.14E-06	1.81E-04	1.69E-03
VOCs				
* 1,2,4-TRIMETHYLBENZENE	8.02E+00	none	3.66E-04	3.42E-03
1,2-DICHLOROETHANE	6.12E-03	8.69E-10	2.79E-07	2.61E-06
* 1,3,5-TRIMETHYLBENZENE	9.30E-01	none	4.25E-05	3.96E-04
2-BUTANONE (MEK)	7.87E-02	NC	3.59E-06	3.35E-05
ACETONE	1.13E-01	NC	5.18E-06	4.83E-05
* BENZENE	1.10E-02	2.57E-10	5.01E-07	4.68E-06
Carbon Disulfide	7.43E-03	none	1.02E-07	9.50E-07
* ETHYLBENZENE	4.27E-01	NC	1.95E-05	1.82E-04
* ISOPROPYLBENZENE	6.28E-02	none	2.87E-06	2.68E-05
* M/P-XYLENE	7.74E-01	NC	3.54E-05	3.30E-04
METHYLENE CHLORIDE	2.80E-02	3.28E-10	1.28E-06	1.19E-05
* NAPHTHALENE	3.45E-01	NC	1.58E-05	1.47E-04
* N-BUTYLBENZENE	3.11E-03	none	1.42E-07	1.33E-06
* N-PROPYLBENZENE	7.56E-03	none	3.45E-07	3.22E-06
* O-XYLENE	1.39E-01	NC	6.32E-06	5.90E-05
* P-ISOPROPYLTOLUENE	3.91E-02	none	1.78E-06	1.66E-05
* SEC-BUTYLBENZENE	3.04E-02	none	1.39E-06	1.30E-05
* TERT-BUTYLBENZENE	6.30E-03	none	2.88E-07	2.69E-06
TETRACHLOROETHENE	1.00E-03	none	4.57E-08	4.26E-07
* TOLUENE	3.78E-02	NC	1.73E-06	1.61E-05
CHEMICAL CLASS-SPECIFIC RISK =		1.45E-09	5.05E-04	4.71E-03
PCBs				
AROCLOR 1260	2.10E-02	6.56E-08	9.59E-07	8.95E-06
CHEMICAL CLASS-SPECIFIC RISK =		6.56E-08	9.59E-07	9.59E-07
METALS				
Chromium	2.31E+01	NA	2.11E-05	1.97E-04
Cobalt	2.38E+01	NA	5.43E-04	5.07E-03
Molybdenum	1.16E+00	none	3.18E-04	2.97E-03
Nickel	2.76E+01	NA	1.89E-03	1.76E-02
Vanadium	7.93E+01	NA	1.55E-02	1.45E-01

TABLE 7-8
FUTURE RESIDENTIAL SCENARIO FOR ADULT AND CHILD
CANCER RISKS AND TOXICITY HAZARD FROM SUBSURFACE SOIL EXPOSURE
NMCRC-1A

		Cancer Risk	Adult Hazard	Child Hazard
CHEMICAL	EPC (mg/kg)	based on EPA & CA CSF	based on EPA RfD	based on EPA RfD
CHEMICAL CLASS-SPECIFIC RISK =		0.00E+00	1.83E-02	1.71E-01
PATHWAY-SPECIFIC RISK =		3.21E-06	1.90E-02	1.77E-01
PATHWAY-SPECIFIC RISK (Petroleum) =		3.14E-06	6.75E-04	6.30E-03
PATHWAY-SPECIFIC RISK (CERCLA-only) =		6.68E-08	1.83E-02	1.71E-01
INHALATION ROUTE - Particulates ^c / Vapors ^d				
SVOCs ^c				
* BENZ(A)ANTHRACENE	1.40E-01	1.17E-11	1.46E-09	3.40E-09
* Benzo(a)pyrene	1.80E-01	1.85E-10	1.87E-09	4.37E-09
* BENZO(B)FLUORANTHENE	2.90E-01	2.42E-11	3.02E-09	7.04E-09
* BENZO(G,H,I)PERYLENE	8.20E-02	NC	8.54E-10	1.99E-09
* CHRYSENE	2.20E-01	2.27E-12	2.29E-09	5.34E-09
* FLUORANTHENE	2.95E-01	NC	3.07E-09	7.17E-09
* INDENO(1,2,3-CD)PYRENE	8.20E-02	6.85E-12	8.54E-10	1.99E-09
* 2-METHYLNAPHTHALENE	4.01E-01	NC	4.18E-09	9.75E-09
* NAPHTHALENE	5.02E-01	NC	5.23E-09	1.22E-08
* PHENANTHRENE	2.00E-01	NC	2.08E-09	4.86E-09
* PYRENE	3.70E-01	NC	2.57E-09	5.99E-09
CHEMICAL CLASS-SPECIFIC RISK =		2.31E-10	2.75E-08	6.41E-08
VOCs ^d				
* 1,2,4-TRIMETHYLBENZENE	8.02E+00	none	1.93E-07	4.51E-07
1,2-DICHLOROETHANE	6.12E-03	1.71E-08	1.48E-11	3.46E-11
* 1,3,5-TRIMETHYLBENZENE	9.30E-01	none	2.73E-08	6.36E-08
2-BUTANONE (MEK)	7.87E-02	NC	1.89E-12	4.41E-12
ACETONE	1.13E-01	NC	4.01E-11	9.36E-11
* BENZENE	1.10E-02	2.59E-08	1.04E-09	2.44E-09
Carbon disulfide	7.43E-03	none	2.20E-11	5.12E-11
* ETHYLBENZENE	4.27E-01	NC	1.26E-09	2.94E-09
* ISOPROPYLBENZENE	6.28E-02	none	9.78E-11	2.28E-10
* M/P-XYLENE	7.74E-01	NC	1.19E-11	2.77E-11
METHYLENE CHLORIDE	2.80E-02	1.98E-08	8.01E-11	1.87E-10
* NAPHTHALENE	3.45E-01	NC	1.68E-10	3.92E-10
* N-BUTYLBENZENE	3.11E-03	none	5.68E-13	1.33E-12
* N-PROPYLBENZENE	7.56E-03	none	1.38E-12	3.22E-12
* O-XYLENE	1.39E-01	NC	2.13E-12	4.96E-12
* P-ISOPROPYLTOLUENE	3.91E-02	none	8.44E-13	1.97E-12
* SEC-BUTYLBENZENE	3.04E-02	none	1.13E-09	2.63E-09
* TERT-BUTYLBENZENE	6.30E-03	none	2.14E-10	5.00E-10
TETRACHLOROETHENE	1.00E-03	none	8.56E-12	2.00E-11
* TOLUENE	3.78E-02	NC	1.44E-11	3.36E-11
CHEMICAL CLASS-SPECIFIC RISK =		6.28E-08	2.25E-07	5.25E-07
PCBs ^c				
AROCLOR 1260	2.10E-02	4.81E-12	2.19E-07	5.10E-07
CHEMICAL CLASS-SPECIFIC RISK =		4.81E-12	2.18595E-07	5.10055E-07
METALS ^c				

TABLE 7-8
FUTURE RESIDENTIAL SCENARIO FOR ADULT AND CHILD
CANCER RISKS AND TOXICITY HAZARD FROM SUBSURFACE SOIL EXPOSURE
NMCRC-LA

		Cancer Risk	Adult Hazard	Child Hazard
CHEMICAL	EPC (mg/kg)	based on EPA & CA CSF	based on EPA RfD	based on EPA RfD
Chromium	2.31E+01	NA	3.21E-09	7.48E-09
Cobalt	2.38E+01	NA	8.26E-08	1.93E-07
Molybdenum	1.16E+00	none	4.83E-08	1.13E-07
Nickel	2.76E+01	NA	2.87E-07	6.69E-07
Vanadium	7.93E+01	NA	2.36E-06	5.50E-06
CHEMICAL CLASS-SPECIFIC RISK =		0.00E+00	2.78E-06	6.49E-06
PATHWAY-SPECIFIC RISK =		6.31E-08	4.71E-07	1.10E-06
PATHWAY-SPECIFIC RISK (Petroleum) =		2.61E-08	2.52E-07	5.88E-07
PATHWAY-SPECIFIC RISK (CERCLA-only) =		3.70E-08	2.19E-07	5.10E-07
DERMAL ROUTE				
SVOCs				
* BENZ(A)ANTHRACENE	1.40E-01	6.57E-08	4.97E-06	3.26E-05
* Benzo(a)pyrene	1.80E-01	1.04E-06	6.39E-06	4.19E-05
* BENZO(B)FLUORANTHENE	2.90E-01	1.36E-07	1.03E-05	6.75E-05
* BENZO(G,H,I)PERYLENE	8.20E-02	NC	2.91E-06	1.91E-05
* CHRYSENE	2.20E-01	1.27E-08	7.82E-06	5.12E-05
* FLUORANTHENE	2.95E-01	NC	1.05E-05	6.87E-05
* INDENO(1,2,3-CD)PYRENE	8.20E-02	3.85E-08	2.91E-06	1.91E-05
* 2-METHYLNAPHTHALENE	4.01E-01	none	1.43E-05	9.34E-05
* NAPHTHALENE	5.02E-01	NC	1.78E-05	1.17E-04
* PHENANTHRENE	2.00E-01	NC	7.11E-06	4.65E-05
* PYRENE	3.70E-01	NC	8.76E-06	5.74E-05
CHEMICAL CLASS-SPECIFIC RISK =		1.29E-06	9.38E-05	6.14E-04
VOCs				
* 1,2,4-TRIMETHYLBENZENE	8.02E+00	none	4.38E-04	2.87E-03
1,2-DICHLOROETHANE	6.12E-03	2.75E-10	1.11E-07	7.30E-07
* 1,3,5-TRIMETHYLBENZENE	9.30E-01	none	5.08E-05	3.33E-04
2-BUTANONE (MEK)	7.87E-02	NC	7.17E-08	4.70E-07
ACETONE	1.13E-01	NC	6.20E-07	4.06E-06
* BENZENE	1.10E-02	8.14E-11	2.00E-06	1.31E-05
Carbon disulfide	7.43E-03	none	4.06E-08	2.66E-07
* ETHYLBENZENE	4.27E-01	NC	2.33E-06	1.53E-05
* ISOPROPYLBENZENE	6.28E-02	none	3.43E-06	2.25E-05
* M/P-XYLENE	7.74E-01	NC	2.12E-07	1.39E-06
METHYLENE CHLORIDE	2.80E-02	1.04E-10	2.55E-07	1.67E-06
* NAPHTHALENE	3.45E-01	NC	9.43E-06	6.18E-05
* N-BUTYLBENZENE	3.11E-03	none	1.70E-07	1.11E-06
* N-PROPYLBENZENE	7.56E-03	none	4.13E-07	2.71E-06
* O-XYLENE	1.39E-01	NC	3.79E-08	2.48E-07
* P-ISOPROPYLTOLUENE	3.91E-02	none	1.07E-07	6.99E-07
* SEC-BUTYLBENZENE	3.04E-02	none	1.66E-06	1.09E-05
* TERT-BUTYLBENZENE	6.30E-03	none	3.44E-07	2.26E-06
TETRACHLOROETHENE	1.00E-03	none	5.47E-08	3.58E-07
* TOLUENE	3.78E-02	NC	1.03E-07	6.77E-07

TABLE 7-8
FUTURE RESIDENTIAL SCENARIO FOR ADULT AND CHILD
CANCER RISKS AND TOXICITY HAZARD FROM SUBSURFACE SOIL EXPOSURE
NMCRC-LA

		Cancer Risk	Adult Hazard	Child Hazard
CHEMICAL	EPC (mg/kg)	based on EPA & CA CSF	based on EPA RfD	based on EPA RfD
CHEMICAL CLASS-SPECIFIC RISK =		4.60E-10	5.11E-04	3.34E-03
PCBs				
AROCOR 1260	2.10E-02	2.91E-08	8.03E-04	5.26E-03
CHEMICAL CLASS-SPECIFIC RISK =		2.91E-08	8.03E-04	5.26E-03
METALS				
Chromium	2.31E+01	NA	8.42E-07	5.52E-06
Cobalt	2.38E+01	NA	2.17E-05	1.42E-04
Molybdenum	1.16E+00	none	1.27E-05	8.31E-05
Nickel	2.76E+01	NA	7.53E-05	4.93E-04
Vanadium	7.93E+01	NA	6.19E-04	4.06E-03
CHEMICAL CLASS-SPECIFIC RISK =		0.00E+00	7.30E-04	4.78E-03
PATHWAY-SPECIFIC RISK =		1.32E-06	2.14E-03	1.40E-02
PATHWAY-SPECIFIC RISK (Petroleum) =		1.29E-06	6.03E-04	3.95E-03
PATHWAY-SPECIFIC RISK (CERCLA-only) =		2.95E-08	1.53E-03	1.00E-02
TOTAL:		4.60E-06	2.11E-02	1.91E-01
Petroleum-related:		4.47E-06	1.28E-03	1.03E-02
CERCLA-only:		1.33E-07	1.98E-02	1.81E-01

* = Petroleum-related chemical

CPF = Cancer Potency Factor

CDI = Chronic daily intake

mg/kg-day = milligrams per kilogram per day

EPC = Exposure Point Concentration

NA = Not Available

NC = Not a known carcinogen

NMCRC-LA = Naval and Marine Corps Reserve Center- Los Angeles

RfD = Reference Dose

a= No RfD located. Surrogate toxicity value used based on structure relationship

b = Surrogate toxicity value used based on EPA Region IX PRG Table, 1999

c = Chemicals having a Henry's Law Constant below 10^5 and a molecular weight greater than 200 g/mol.

d = Chemicals having a Henry's Law Constant greater than 10^{-5} and a molecular weight less than 200 g/mol.

e = Toxicity criteria from EPA Region 9 Preliminary Remediation Goals, 1999

f = If a CPF was available from the U.S. EPA but not from the California EPA, the EPA CPF was used in California

TABLE 7-9
Future Residential Scenario for Adult and Child
Cancer Risks and Toxicity Hazard from Exposure to Groundwater
NMCRC-LA

CHEMICAL	EPC (mg/l)	CalCSF (Chronic) (mg/kg-day) ⁻¹	EPA CSF (Chronic) (mg/kg-day) ⁻¹	Cancer Risk Based On California CSF ^(a)	Cancer Risk Based On EPA CSF	CDI ^(b) Child (noncancer) (mg/kg-day)	CDI ^(b) Adult (noncancer) (mg/kg-day)	Reference Dose (mg/kg-day)	Systemic Risk to Children	Systemic Risk to Adults
GROUNDWATER INGESTION ROUTE										
<i>SVOCs</i>										
DI-N-BUTYLPHTHALATE	8.71E-03	NA	NA	NA	NA	5.57E-04	2.39E-04	1.00E-01	(c) 5.57E-03	2.39E-03
2-METHYLNAPHTHALENE	1.11E-02	NA	NA	NA	NA	7.08E-04	3.03E-04	2.00E-02	(d) 3.54E-02	1.52E-02
NAPHTHALENE	2.37E-02	NA	NA	NA	NA	1.52E-03	6.51E-04	2.00E-02	(e) 7.59E-02	3.25E-02
CHEMICAL CLASS-SPECIFIC RISK =				0.00E+00	0.00E+00				0.12	0.05
<i>POCs</i>										
1,2,4-TRIMETHYLBENZENE	7.42E-02	NA	NA	NA	NA	4.74E-03	2.03E-03	5.00E-02	(f) 9.49E-02	4.07E-02
1,2-DICHLOROETHANE	1.33E-02	7.00E-02	9.10E-02	1.39E-05	1.80E-05	8.51E-04	3.65E-04	3.00E-02	(g) 2.84E-02	1.22E-02
1,3,5-TRIMETHYLBENZENE	1.82E-02	NA	NA	NA	NA	1.17E-03	5.00E-04	5.00E-02	(h) 2.33E-02	9.99E-03
BENZENE	3.78E-02	1.00E-01	2.90E-02	5.62E-05	1.63E-05	2.42E-03	1.04E-03	3.00E-03	(i) 8.03E-01	3.45E-01
CARBON DISULFIDE	1.00E-03	NA	NA	NA	NA	6.39E-05	2.74E-05	1.00E-01	(j) 6.39E-04	2.74E-04
CHLOROFORM	4.03E-03	3.10E-02	6.10E-03	1.86E-06	3.66E-07	2.58E-04	1.10E-04	1.00E-02	(k) 2.58E-02	1.10E-02
ETHYLBENZENE	2.26E-02	NA	NA	NA	NA	1.44E-03	6.19E-04	1.00E-01	(l) 1.44E-02	6.19E-03
ISOPROPYLBENZENE	7.35E-03	NA	NA	NA	NA	4.70E-04	2.01E-04	1.00E-01	(m) 4.70E-03	2.01E-03
MP-XYLENE	4.10E-02	NA	NA	NA	NA	2.62E-03	1.12E-03	2.00E+00	(n) 1.31E-03	5.61E-04
NAPHTHALENE	1.31E-02	NA	NA	NA	NA	8.39E-04	3.60E-04	2.00E-02	(o) 4.19E-02	1.80E-02
N-PROPYLBENZENE	1.82E-02	NA	NA	NA	NA	1.17E-03	4.99E-04	1.00E-02	(p) 1.17E-01	4.99E-02
O-XYLENE	1.74E-02	NA	NA	NA	NA	1.11E-03	4.77E-04	2.00E+00	(q) 5.56E-04	2.38E-04
P-ISOPROPYLTOLUENE	3.87E-03	NA	NA	NA	NA	2.47E-04	1.06E-04	NA	NA	NA
SEC-BUTYLBENZENE	4.09E-03	NA	NA	NA	NA	2.61E-04	1.12E-04	1.00E-02	(r) 2.61E-02	1.12E-02
TERT-BUTYLBENZENE	1.00E-03	NA	NA	NA	NA	6.39E-05	2.74E-05	1.00E-02	(s) 6.39E-03	2.74E-03
TETRACHLOROETHENE	2.00E-03	5.10E-02	5.20E-02	1.52E-06	1.55E-06	1.28E-04	5.48E-05	1.00E-02	(t) 1.28E-02	5.48E-03
TOLUENE	1.60E-02	NA	NA	NA	NA	1.02E-03	4.38E-04	2.00E-01	(u) 5.11E-03	2.19E-03
CHEMICAL CLASS-SPECIFIC RISK =				7.34E-05	3.62E-05				1.21	0.52
<i>METALS</i>										
Barium	1.77E-01	N/C	N/C	N/C	N/C	1.13E-02	4.85E-03	7.00E-02	1.62E-01	6.93E-02
Cobalt	8.86E-03	NA	NA	NA	NA	5.66E-04	2.43E-04	6.00E-02	(v) 9.44E-03	4.05E-03
Lead	1.44E-03	NA	NA	NA	NA	9.19E-05	3.94E-05	NA	NA	NA
Nickel	1.63E-02	NA	NA	NA	NA	1.06E-03	4.53E-04	2.00E-02	(w) 5.28E-02	2.26E-02
Molybdenum	9.24E-02	none	none	none	none	5.91E-03	2.53E-03	5.00E-03	1.18E+00	5.06E-01
Antimony	5.80E-03	NA	NA	NA	NA	3.70E-04	1.59E-04	4.00E-04	9.26E-01	3.97E-01
Zinc	1.90E-02	NA	NA	NA	NA	1.22E-03	5.21E-04	3.00E-01	4.03E-03	1.74E-03
CHEMICAL CLASS-SPECIFIC RISK =				0.00E+00	0.00E+00				2.3	1.0
PATHWAY-SPECIFIC RISK =				7.34E-05	3.62E-05				3.7	1.6
INHALATION ROUTE - Vapors										
<i>SVOCs</i>										
DI-N-BUTYLPHTHALATE	8.71E-03	NA	NA	NA	NA	9.74E-05	2.09E-05	1.00E-01	(x) 9.74E-04	2.09E-04
2-METHYLNAPHTHALENE	1.11E-02	NA	NA	NA	NA	1.24E-04	2.63E-05	NA	NA	NA
NAPHTHALENE	2.37E-02	NA	NA	NA	NA	2.66E-04	5.69E-05	8.60E-04	(y) 3.09E-01	6.62E-02
CHEMICAL CLASS-SPECIFIC RISK =				0.00E+00	0.00E+00				0.31	0.07
<i>POCs</i>										
1,2,4-TRIMETHYLBENZENE	7.42E-02	NA	NA	NA	NA	8.30E-04	1.78E-04	1.70E-03	(z) 4.88E-01	1.03E-01
1,2-DICHLOROETHANE	1.33E-02	7.00E-02	9.10E-02	1.66E-06	2.16E-06	1.49E-04	3.19E-05	1.40E-03	(aa) 1.06E-01	2.28E-02
1,3,5-TRIMETHYLBENZENE	1.82E-02	NA	NA	NA	NA	2.04E-04	4.37E-05	1.70E-03	(ab) 1.20E-01	2.57E-02

TABLE 7-9
Future Residential Scenario for Adult and Child
Cancer Risks and Toxicity Hazard from Exposure to Groundwater
NMCRC-LA

CHEMICAL	EPC (mg/l)	CDI (cancer) (mg/kg-day) ¹	CalCSF (Chronic) (mg/kg-day) ¹	EPA CSF (Chronic) (mg/kg-day) ¹	Cancer Risk Based On California CSF ^{1a}	Cancer Risk Based On EPA CSF	CDI ^{1b} Child (mg/kg-day)	CDI ^{1b} Adult (noncancer) (mg/kg-day)	Reference Dose (mg/kg-day)	Systemic Risk to Children	Systemic Risk to Adults
BENZENE	3.78E-02	6.73E-05	1.00E-01	2.70E-02	6.73E-06	1.82E-06	4.23E-04	9.06E-05	1.70E-03	2.49E-01	5.33E-02
CARBON DISULFIDE	1.00E-03	1.78E-06	NA	NA	NA	NA	1.12E-05	2.40E-06	2.00E-01	5.59E-05	1.20E-05
CHLOROFORM	4.03E-03	7.17E-06	1.90E-02	8.10E-02	1.36E-07	5.81E-07	4.51E-05	9.66E-06	8.60E-05	5.24E-01	1.12E-01
ETHYLENE	2.26E-02	4.02E-05	NA	NA	NA	NA	2.53E-04	5.42E-05	2.90E-01	8.71E-04	1.87E-04
ISOPROPYLBENZENE	7.35E-03	1.31E-05	NA	NA	NA	NA	8.22E-05	1.76E-05	1.10E-01	7.47E-04	1.60E-04
MP-XYLENE	4.10E-02	7.30E-05	NA	NA	NA	NA	4.58E-04	9.82E-05	NA	NA	NA
NAPHTHALENE	1.31E-02	2.34E-05	NA	NA	NA	NA	1.47E-04	3.15E-05	8.60E-04	1.71E-01	3.66E-02
N-PROPYLBENZENE	1.82E-02	3.25E-05	NA	NA	NA	NA	2.04E-04	4.37E-05	1.00E-02	2.04E-02	4.37E-03
O-XYLENE	1.74E-02	3.10E-05	NA	NA	NA	NA	1.95E-04	4.17E-05	NA	NA	NA
P-ISOPROPYLTOLUENE	3.87E-03	6.89E-06	NA	NA	NA	NA	4.33E-05	9.27E-06	NA	NA	NA
SEC-BUTYLBENZENE	4.09E-03	7.28E-06	NA	NA	NA	NA	4.38E-05	9.80E-06	1.00E-02	4.58E-03	9.80E-04
TERT-BUTYLBENZENE	1.00E-03	1.78E-06	NA	NA	NA	NA	1.12E-05	2.40E-06	1.00E-02	1.12E-03	2.40E-04
TETRACHLOROETHENE	2.00E-03	3.56E-06	2.10E-02	2.00E-03	7.48E-08	7.12E-09	2.24E-05	4.79E-06	1.10E-01	2.03E-04	4.36E-05
TOLUENE	1.60E-02	2.84E-05	NA	NA	NA	NA	1.79E-04	3.83E-05	1.10E-01	1.62E-03	3.48E-04
CHEMICAL CLASS-SPECIFIC RISK =					8.60E-06	4.56E-06				1.69	0.36
PATHWAY-SPECIFIC RISK =					8.60E-06	4.56E-06				2.00	0.43
DERMAL ABSORPTION FROM SHOWER											
SVOCs											
DI-N-BUTYLPHTHALATE	8.71E-03	6.35E-07	NA	NA	NA	NA	2.28E-06	1.28E-06	1.00E-01	2.28E-05	1.28E-05
2-METHYLNAPHTHALENE	1.11E-02	6.96E-05	NA	NA	NA	NA	2.50E-04	1.40E-04	2.00E-02	1.25E-02	7.02E-03
NAPHTHALENE	2.37E-02	1.49E-04	NA	NA	NA	NA	5.37E-04	3.01E-04	2.00E-02	2.69E-02	1.51E-02
CHEMICAL CLASS-SPECIFIC RISK =					0.00E+00	0.00E+00				3.94E-02	2.21E-02
POCS											
1,2,4-TRIMETHYLBENZENE	7.42E-02	4.60E-06	NA	NA	NA	NA	1.65E-05	9.28E-06	5.00E-02	3.31E-04	1.86E-04
1,2-DICHLOROETHANE	1.33E-02	6.43E-06	7.00E-02	9.10E-02	4.50E-07	5.83E-07	2.31E-05	1.30E-05	3.00E-02	7.71E-04	4.32E-04
1,3,5-TRIMETHYLBENZENE	1.82E-02	1.13E-06	NA	NA	NA	NA	4.06E-06	2.28E-06	5.00E-02	8.13E-05	4.56E-05
BENZENE	3.78E-02	7.23E-05	1.00E-01	2.90E-02	7.23E-06	2.10E-06	1.10E-04	6.18E-05	3.00E-03	3.67E-02	2.06E-02
CARBON DISULFIDE	1.00E-03	6.29E-06	NA	NA	NA	NA	2.62E-07	1.47E-07	1.00E-01	2.62E-06	1.47E-06
CHLOROFORM	4.03E-03	3.27E-06	3.10E-02	6.10E-03	1.01E-07	1.99E-08	2.77E-05	1.56E-05	1.00E-02	2.77E-03	1.56E-03
ETHYLENE	2.26E-02	1.52E-04	NA	NA	NA	NA	5.48E-04	3.07E-04	1.00E-01	5.48E-03	3.07E-03
ISOPROPYLBENZENE	7.35E-03	5.96E-07	NA	NA	NA	NA	2.14E-06	1.20E-06	1.00E-01	2.14E-05	1.20E-05
MP-XYLENE	4.10E-02	2.99E-04	NA	NA	NA	NA	1.07E-03	6.02E-04	2.00E+00	5.37E-04	3.01E-04
NAPHTHALENE	1.31E-02	8.25E-05	NA	NA	NA	NA	2.97E-04	1.66E-04	2.00E-02	1.48E-02	8.32E-03
N-PROPYLBENZENE	1.82E-02	1.15E-05	NA	NA	NA	NA	4.12E-05	2.31E-05	1.00E-02	4.12E-03	2.31E-03
O-XYLENE	1.74E-02	1.27E-04	NA	NA	NA	NA	4.56E-04	2.56E-04	2.00E+00	2.28E-04	1.28E-04
P-ISOPROPYLTOLUENE	3.87E-03	3.14E-07	NA	NA	NA	NA	1.13E-06	6.33E-07	NA	NA	NA
SEC-BUTYLBENZENE	4.09E-03	2.98E-07	NA	NA	NA	NA	1.07E-06	6.01E-07	1.00E-02	1.07E-04	6.01E-05
TERT-BUTYLBENZENE	1.00E-03	7.29E-08	NA	NA	NA	NA	2.62E-07	1.47E-07	1.00E-02	2.62E-05	1.47E-05
TETRACHLOROETHENE	2.00E-03	6.74E-05	5.10E-02	5.20E-02	3.44E-06	3.51E-06	2.43E-04	1.36E-04	1.00E-02	2.43E-02	1.36E-02
TOLUENE	1.60E-02	6.55E-05	NA	NA	NA	NA	2.36E-04	1.32E-04	2.00E-01	1.18E-03	6.61E-04
CHEMICAL CLASS-SPECIFIC RISK =					1.12E-05	6.21E-06				0.09	0.05
METALS											
Barium	1.77E-01	7.25E-04	N/C	N/C	N/C	N/C	5.80E-05	3.25E-05	7.00E-02	8.29E-04	4.65E-04
Cobalt	8.86E-03	3.63E-05	NA	NA	NA	NA	2.90E-06	1.63E-06	6.00E-02	4.84E-05	2.71E-05

TABLE 7-9

Future Residential Scenario for Adult and Child
Cancer Risks and Toxicity Hazard from Exposure to Groundwater
NMCRC-LA

CHEMICAL	EPC (mg/l)	CDI (cancer) (mg/kg-day)	CalCSF (Chronic) (mg/kg-day) ⁻¹	EPA CSF (Chronic) (mg/kg-day) ⁻¹	Cancer Risk Based On California CSF ^(a)	Cancer Risk Based On EPA CSF	CDI ^(b) Child (noncancer) (mg/kg-day)	CDI ^(b) Adult (noncancer) (mg/kg-day)	Reference Dose (mg/kg-day)	Systemic Risk to Children	Systemic Risk to Adults
Lead	1.44E-03	5.89E-06	NA	NA ^d	NA	NA	4.71E-07	2.64E-07	NA	NA	NA
Nickel	1.65E-02	6.78E-05	NA	NA	NA	NA	5.42E-06	3.04E-06	2.00E-02	2.71E-04	1.52E-04
Molybdenum	9.24E-02	3.79E-04	none	none	none	none	3.03E-05	1.70E-05	5.00E-03	6.06E-03	3.40E-03
Antimony	5.80E-03	2.38E-05	NA	NA	NA	NA	1.90E-06	1.07E-06	4.00E-04	4.75E-03	2.66E-03
Zinc	1.90E-02	7.79E-05	NA	NA	NA	NA	6.23E-06	3.49E-06	3.00E-01	2.08E-05	1.16E-05
CHEMICAL CLASS-SPECIFIC RISK =											
PATHWAY-SPECIFIC RISK =											
						TOTAL CANCER RISK =					
						9.33E-05					
						4.70E-05					
						5.80					
						2.08					
						HAZARD =					

(a) = If a CSF was available from the U.S. EPA but not from the California EPA, the EPA CSF was used in California EPA calculations.

(b) = CDI values not adjusted

(c) = Integrated Risk Information System

(d) = The EPA does not recommend applying a CSF to lead to substantial uncertainty in epidemiological data

(e) = Surrogate toxicity value used based on EPA Region IX PRG Table, October 1999.

(f) = Health Effects Assessment Summary Tables

(g) = Toxicity criteria from EPA Region IX Preliminary Remediation Goals, October 1999

CSF = Cancer Slope Factor

CDI = Chronic daily intake

mg/kg-day = milligrams per kilogram per day

EPC = Exposure Point Concentration

NA = Not Available

NC = not a known carcinogen

NMCRC-LA = Naval and Marine Corps Reserve Center, Los Angeles

RD = Reference Dose

TABLE 7-10
Future Residential Scenario for Adult and Child Based on Groundwater Modeled Data
Cancer Risks and Toxicity Hazard from Exposure to Modeled Groundwater Chemical Concentrations
NMCRC-LA

CHEMICAL	EPC (mg/l)	CDI (cancer) (mg/kg-day)	CalCSF (Chronic) (mg/kg-day) ⁻¹	EPA CSF (Chronic) (mg/kg-day) ⁻¹	Cancer Risk Based On California CSF ^(a)	Cancer Risk Based On EPA CSF	CDI* Child (noncancer) (mg/kg-day)	CDI* Adult (noncancer) (mg/kg-day)	Reference Dose (mg/kg-day)	Systemic Risk to Children	Systemic Risk to Adults
GROUNDWATER INGESTION ROUTE											
<i>SVOCs</i>											
DI-N-BUTYLPHTHALATE	8.71E-03	1.30E-04	NA	NA	NA	NA	5.57E-04	2.39E-04	1.00E-01	(e) 5.57E-03	2.39E-03
2-METHYLNAPHTHALENE	1.11E-02	1.65E-04	NA	NA	NA	NA	7.08E-04	3.03E-04	2.00E-02	(f) 3.54E-02	1.52E-02
NAPHTHALENE	2.37E-02	3.53E-04	NA	NA	NA	NA	1.52E-03	6.51E-04	2.00E-02	(e) 7.59E-02	3.25E-02
CHEMICAL CLASS-SPECIFIC RISK =					0.00E+00	0.00E+00				0.12	0.05
<i>POCs</i>											
1,2,4-TRIMETHYLBENZENE	2.03E-02	3.02E-04	NA	NA	NA	NA	1.30E-03	5.56E-04	5.00E-02	(g) 2.60E-02	1.11E-02
1,2-DICHLOROETHANE	1.00E-03	1.49E-05	7.00E-02	9.10E-02	1.04E-06	1.35E-06	6.39E-05	2.74E-05	3.00E-02	(g) 2.13E-03	9.13E-04
1,3,5-TRIMETHYLBENZENE	5.70E-03	8.48E-05	NA	NA	NA	NA	3.64E-04	1.56E-04	5.00E-02	(g) 7.29E-03	3.12E-03
BENZENE	4.00E-03	5.95E-05	1.00E-01	2.90E-02	5.95E-06	1.73E-06	2.56E-04	1.10E-04	3.00E-03	(g) 8.52E-02	3.65E-02
CARBON DISULFIDE	1.00E-03	1.49E-05	NA	NA	NA	NA	6.39E-05	2.74E-05	1.00E-01	(e) 6.39E-04	2.74E-04
CHLOROFORM	4.03E-03	5.99E-05	3.10E-02	6.10E-03	1.86E-06	3.66E-07	2.58E-04	1.10E-04	1.00E-02	(e) 2.58E-02	1.10E-02
ETHYLBENZENE	2.26E-02	3.36E-04	NA	NA	NA	NA	1.44E-03	6.19E-04	1.00E-01	(e) 1.44E-02	6.19E-03
ISOPROPYLBENZENE	7.33E-03	1.09E-04	NA	NA	NA	NA	4.70E-04	2.01E-04	1.00E-01	(e) 4.70E-03	2.01E-03
M/P-XYLENE	4.10E-02	6.09E-04	NA	NA	NA	NA	2.62E-03	1.12E-03	2.00E+00	(e) 1.31E-03	5.61E-04
NAPHTHALENE	1.31E-02	1.95E-04	NA	NA	NA	NA	8.39E-04	3.60E-04	2.00E-02	(e) 4.19E-02	1.80E-02
N-PROPYLBENZENE	1.82E-02	2.71E-04	NA	NA	NA	NA	1.17E-03	4.99E-04	1.00E-02	(g) 1.17E-01	4.99E-02
O-XYLENE	1.74E-02	2.59E-04	NA	NA	NA	NA	1.11E-03	4.77E-04	2.00E+00	(e) 5.56E-04	2.38E-04
P-ISOPROPYLTOLUENE	3.87E-03	5.75E-05	NA	NA	NA	NA	2.47E-04	1.06E-04	NA	NA	NA
SEC-BUTYLBENZENE	4.09E-03	6.08E-05	NA	NA	NA	NA	2.61E-04	1.12E-04	1.00E-02	(g) 2.61E-02	1.12E-02
TERT-BUTYLBENZENE	1.00E-03	1.49E-05	NA	NA	NA	NA	6.39E-05	2.74E-05	1.00E-02	(g) 6.39E-03	2.74E-03
TETRACHLOROETHENE	2.00E-03	2.97E-05	5.10E-02	5.20E-02	1.52E-06	1.55E-06	1.28E-04	5.48E-05	1.00E-02	(e) 1.28E-02	5.48E-03
TOLUENE	1.60E-02	2.38E-04	NA	NA	NA	NA	1.02E-03	4.38E-04	2.00E-01	(e) 5.11E-03	2.19E-03
CHEMICAL CLASS-SPECIFIC RISK =					1.04E-05	4.99E-06				0.38	0.16
<i>METALS</i>											
Barium	1.77E-01	2.63E-03	N/C	N/C	N/C	N/C	1.13E-02	4.85E-03	7.00E-02	1.62E-01	6.93E-02
Cobalt	8.86E-03	1.32E-04	NA	NA	NA	NA	5.66E-04	2.43E-04	6.00E-02	(e) 9.44E-03	4.05E-03
Lead	1.44E-03	2.14E-05	NA	NA ^d	NA	NA	9.19E-05	3.94E-05	NA	NA	NA
Nickel	1.65E-02	2.46E-04	NA	NA	NA	NA	1.06E-03	4.53E-04	2.00E-02	(e) 5.28E-02	2.26E-02
Molybdenum	9.24E-02	1.37E-03	none	none	none	none	5.91E-03	2.53E-03	5.00E-03	1.18E+00	5.06E-01
Antimony	5.80E-03	8.62E-05	NA	NA	NA	NA	3.70E-04	1.59E-04	4.00E-04	9.26E-01	3.97E-01
Zinc	1.90E-02	2.83E-04	NA	NA	NA	NA	1.22E-03	5.21E-04	3.00E-01	4.05E-03	1.74E-03
CHEMICAL CLASS-SPECIFIC RISK =					0.00E+00	0.00E+00				2.3	1.0
PATHWAY-SPECIFIC RISK =					1.04E-05	4.99E-06				2.8	1.2
INHALATION ROUTE - Vapors											

TABLE 7-10
Future Residential Scenario for Adult and Child Based on Groundwater Modeled Data
Cancer Risks and Toxicity Hazard from Exposure to Modeled Groundwater Chemical Concentrations
NMCRC-LA

CHEMICAL	EPC (mg/l)	CDI (cancer) (mg/kg-day)	CalCSF (Chronic) (mg/kg-day) ⁻¹	EPA CSF (Chronic) (mg/kg-day) ⁻¹	Cancer Risk Based On California CSF ^(a)	Cancer Risk Based On EPA CSF	CDI* Child (noncancer) (mg/kg-day)	CDI* Adult (noncancer) (mg/kg-day)	Reference Dose (mg/kg-day)	Systemic Risk to Children	Systemic Risk to Adults
SVOCs											
D,N-BUTYLPHTHALATE	8.71E-03	1.55E-05	NA	NA	NA	NA	9.74E-05	2.09E-05	1.00E-01	(e) 9.74E-04	2.09E-04
2-METHYLNAPHTHALENE	1.11E-02	1.97E-05	NA	NA	NA	NA	1.24E-04	2.65E-05	NA	NA	NA
NAPHTHALENE	2.37E-02	4.23E-05	NA	NA	NA	NA	2.66E-04	5.69E-05	8.60E-04	(e) 3.09E-01	6.62E-02
CHEMICAL CLASS-SPECIFIC RISK =					0.00E+00	0.00E+00				0.31	0.07
VOCs											
1,2,4-TRIMETHYLBENZENE	2.03E-02	3.62E-05	NA	NA	NA	NA	2.27E-04	4.87E-05	1.70E-03	(e) 1.34E-01	2.86E-02
1,2-DICHLOROETHANE	1.00E-03	1.78E-06	7.00E-02	9.10E-02	1.25E-07	1.62E-07	1.12E-05	2.40E-06	1.40E-03	(e) 7.99E-03	1.71E-03
1,3,5-TRIMETHYLBENZENE	5.70E-03	1.02E-05	NA	NA	NA	NA	6.38E-05	1.37E-05	1.70E-03	(e) 3.75E-02	8.04E-03
BENZENE	4.00E-03	7.12E-06	1.00E-01	2.70E-02	7.12E-07	1.92E-07	4.47E-05	9.59E-06	1.70E-03	(e) 2.63E-02	5.64E-03
CARBON DISULFIDE	1.00E-03	1.78E-06	NA	NA	NA	NA	1.12E-05	2.40E-06	2.00E-01	(e) 5.59E-05	1.20E-05
CHLOROFORM	4.03E-03	7.17E-06	1.90E-02	8.10E-02	1.36E-07	5.81E-07	4.51E-05	9.66E-06	8.60E-05	(e) 5.24E-01	1.12E-01
ETHYLBENZENE	2.26E-02	4.02E-05	NA	NA	NA	NA	2.53E-04	5.42E-05	2.90E-01	(e) 8.71E-04	1.87E-04
ISOPROPYLBENZENE	7.35E-03	1.31E-05	NA	NA	NA	NA	8.22E-05	1.76E-05	1.10E-01	(e) 7.47E-04	1.60E-04
M/P-XYLENE	4.10E-02	7.30E-05	NA	NA	NA	NA	4.58E-04	9.82E-05	NA	NA	NA
NAPHTHALENE	1.31E-02	2.34E-05	NA	NA	NA	NA	1.47E-04	3.15E-05	8.60E-04	(e) 1.71E-01	3.66E-02
N-PROPYLBENZENE	1.82E-02	3.25E-05	NA	NA	NA	NA	2.04E-04	4.37E-05	1.00E-02	(e) 2.04E-02	4.37E-03
O-XYLENE	1.74E-02	3.10E-05	NA	NA	NA	NA	1.93E-04	4.17E-05	NA	NA	NA
P-ISOPROPYLTOLUENE	3.87E-03	6.89E-06	NA	NA	NA	NA	4.33E-05	9.27E-06	NA	NA	NA
SEC-BUTYLBENZENE	4.09E-03	7.28E-06	NA	NA	NA	NA	4.58E-05	9.80E-06	1.00E-02	(e) 4.58E-03	9.80E-04
TERT-BUTYLBENZENE	1.00E-03	1.78E-06	NA	NA	NA	NA	1.12E-05	2.40E-06	1.00E-02	(e) 1.12E-03	2.40E-04
TETRACHLOROETHENE	2.00E-03	3.56E-06	2.10E-02	2.00E-03	7.48E-08	7.12E-09	2.24E-05	4.79E-06	1.10E-01	(e) 2.03E-04	4.36E-05
TOLUENE	1.60E-02	2.84E-05	NA	NA	NA	NA	1.79E-04	3.83E-05	1.10E-01	(e) 1.62E-03	3.48E-04
CHEMICAL CLASS-SPECIFIC RISK =					1.05E-06	9.43E-07				0.93	0.20
PATHWAY-SPECIFIC RISK =					1.05E-06	9.43E-07				1.24	0.27

TABLE 7-10
Future Residential Scenario for Adult and Child Based on Groundwater Modeled Data
Cancer Risks and Toxicity Hazard from Exposure to Modeled Groundwater Chemical Concentrations
NMCR-LA

CHEMICAL	EPC (mg/l)	CDI (cancer) (mg/kg-day)	CalCSF (Chronic) (mg/kg-day) ⁻¹	EPA CSF (Chronic) (mg/kg-day) ⁻¹	Cancer Risk Based On California CSF ^(a)	Cancer Risk Based On EPA CSF	CDI* Child (noncancer) (mg/kg-day)	CDI* Adult (noncancer) (mg/kg-day)	Reference Dose (mg/kg-day)	Systemic Risk to Children	Systemic Risk to Adults
DERMAL ABSORPTION FROM SHOWER											
<i>S/OCS</i>											
DI-N-BUTYLPHTHALATE	8.71E-03	6.35E-07	NA	NA	NA	NA	2.28E-06	1.28E-06	1.00E-01	(e) 2.28E-05	1.28E-05
2-METHYLNAPHTHALENE	1.11E-02	6.96E-05	NA	NA	NA	NA	2.50E-04	1.40E-04	2.00E-02	(f) 1.25E-02	7.02E-03
NAPHTHALENE	2.37E-02	1.49E-04	NA	NA	NA	NA	5.37E-04	3.01E-04	2.00E-02	(e) 2.69E-02	1.51E-02
CHEMICAL CLASS-SPECIFIC RISK =					0.00E+00	0.00E+00				3.94E-02	2.21E-02
<i>VOCs</i>											
1,2,4-TRIMETHYLBENZENE	2.03E-02	1.26E-06	NA	NA	NA	NA	4.52E-06	2.54E-06	5.00E-02	(e) 9.05E-05	5.07E-05
1,2-DICHLOROETHANE	1.00E-03	4.83E-07	7.00E-02	9.10E-02	3.38E-08	4.39E-08	1.74E-06	9.74E-07	3.00E-02	(e) 5.79E-05	3.25E-05
1,3,5-TRIMETHYLBENZENE	5.70E-03	3.53E-07	NA	NA	NA	NA	1.27E-06	7.12E-07	5.00E-02	(e) 2.54E-05	1.42E-05
BENZENE	4.00E-03	7.65E-06	1.00E-01	2.90E-02	7.65E-07	2.22E-07	1.17E-05	6.54E-06	3.00E-03	(e) 3.89E-03	2.18E-03
CARBON DISULFIDE	1.00E-03	6.29E-06	NA	NA	NA	NA	2.62E-07	1.47E-07	1.00E-01	(e) 2.62E-06	1.47E-06
CHLOROFORM	4.03E-03	3.27E-06	3.10E-02	6.10E-03	1.01E-07	1.99E-08	2.77E-05	1.56E-05	1.00E-02	(e) 2.77E-03	1.56E-03
ETHYLBENZENE	2.26E-02	1.52E-04	NA	NA	NA	NA	5.48E-04	3.07E-04	1.00E-01	(e) 5.48E-03	3.07E-03
ISOPROPYLBENZENE	7.35E-03	5.96E-07	NA	NA	NA	NA	2.14E-06	1.20E-06	1.00E-01	(e) 2.14E-05	1.20E-05
M/P-XYLENE	4.10E-02	2.99E-04	NA	NA	NA	NA	1.07E-03	6.02E-04	2.00E+00	(e) 5.37E-04	3.01E-04
NAPHTHALENE	1.31E-02	8.25E-05	NA	NA	NA	NA	2.97E-04	1.66E-04	2.00E-02	(e) 1.48E-02	8.32E-03
N-PROPYLBENZENE	1.82E-02	1.15E-05	NA	NA	NA	NA	4.12E-05	2.31E-05	1.00E-02	(e) 4.12E-03	2.31E-03
O-XYLENE	1.74E-02	1.27E-04	NA	NA	NA	NA	4.56E-04	2.56E-04	2.00E+00	(e) 2.28E-04	1.28E-04
P-ISOPROPYL TOLUENE	3.87E-03	3.14E-07	NA	NA	NA	NA	1.13E-06	6.33E-07	NA	NA	NA
SEC-BUTYLBENZENE	4.09E-03	2.98E-07	NA	NA	NA	NA	1.07E-06	6.01E-07	1.00E-02	(e) 1.07E-04	6.01E-05
TERT-BUTYLBENZENE	1.00E-03	7.29E-08	NA	NA	NA	NA	2.62E-07	1.47E-07	1.00E-02	(e) 2.62E-05	1.47E-05
TETRACHLOROETHENE	2.00E-03	6.74E-05	5.10E-02	5.20E-02	3.44E-06	3.51E-06	2.43E-04	1.36E-04	1.00E-02	(e) 2.43E-02	1.36E-02
TOLUENE	1.60E-02	6.55E-05	NA	NA	NA	NA	2.36E-04	1.32E-04	2.00E-01	(e) 1.18E-03	6.61E-04
CHEMICAL CLASS-SPECIFIC RISK =					4.34E-06	3.79E-06				0.06	0.03
<i>METALS</i>											
Barium	1.77E-01	7.23E-04	N/C	N/C	N/C	N/C	5.80E-05	3.25E-05	7.00E-02	8.29E-04	4.65E-04
Cobalt	8.86E-03	3.63E-05	NA	NA	NA	NA	2.90E-06	1.63E-06	6.00E-02	(e) 4.84E-05	2.71E-05
Lead	1.44E-03	5.89E-06	NA	NA ^d	NA	NA	4.71E-07	2.64E-07	NA	NA	NA
Nickel	1.65E-02	6.78E-05	NA	NA	NA	NA	5.42E-06	3.04E-06	2.00E-02	(e) 2.71E-04	1.52E-04
Molybdenum	9.24E-02	3.79E-04	none	none	none	none	3.03E-05	1.70E-05	5.00E-03	6.06E-03	3.40E-03
Antimony	5.80E-03	2.38E-05	NA	NA	NA	NA	1.90E-06	1.07E-06	4.00E-04	4.75E-03	2.66E-03

TABLE 7-10
Future Residential Scenario for Adult and Child Based on Groundwater Modeled Data
Cancer Risks and Toxicity Hazard from Exposure to Modeled Groundwater Chemical Concentrations
NMCRC-LA

CHEMICAL	EPC (mg/l)	CDI (cancer) (mg/kg-day)	CalCSF (Chronic) (mg/kg-day) ⁻¹	EPA CSF (Chronic) (mg/kg-day) ⁻¹	Cancer Risk Based On California CSF ^(a)	Cancer Risk Based On EPA CSF	CDI* Child (noncancer) (mg/kg-day)	CDI* Adult (noncancer) (mg/kg-day)	Reference Dose (mg/kg-day)	Systemic Risk to Children	Systemic Risk to Adults
Zinc	1.90E-02	7.79E-05	NA	NA	NA	NA	6.23E-06	3.49E-06	3.00E-01	2.08E-05	1.16E-05
CHEMICAL CLASS-SPECIFIC RISK =					0.00E+00	0.00E+00				0.01	0.01
PATHWAY-SPECIFIC RISK =					4.34E-06	3.79E-06				0.11	0.06
TOTAL CANCER RISK =						1.58E-05	CUMULATIVE TOXICITY HAZARD =				
						9.73E-06					

(a) = If a CSF was available from the U.S. EPA but not from the California EPA, the EPA CSF was used in California EPA calculations.

(b) = CDI values not adjusted

(c) = Integrated Risk Information System

(d) = The EPA does not recommend applying a CSF to lead to substantial uncertainty in epidemiological data

(e) = Surrogate toxicity value used based on EPA Region IX PRG Table, October 1999.

(f) = Health Effects Assessment Summary Tables

(g) = Toxicity criteria from EPA Region IX Preliminary Remediation Goals, October 1999

CSF = Cancer Slope Factor

CDI = Chronic daily intake

mg/kg-day = milligrams per kilogram per day

EPC = Exposure Point Concentration

NA = Not Available

NC = not a known carcinogen

NMCRC-LA = Naval and Marine Corps Reserve Center- Los Angeles

RfD = Reference Dose

Table 7-11
Summary of Excess Lifetime Cancer Risk and Chronic Hazard Index
NMCRC-LA

Characteristic	Risk from Subsurface Soil ^(a)		Risk from Groundwater ^(a)	
	Total	Non-petroleum-related	Total	Non-petroleum-related
Construction Workers				
Total Cancer Risk	2E-09	9E-11	NA	NA
Total Chronic Hazard Index	9E-03	1E-04	NA	NA
Industrial Workers				
Total Cancer Risk	1E-06	4E-08	NA	NA
Total Chronic Hazard Index	2E-01	3E-03	NA	NA
Residents				
Total Cancer Risk	4E-06	1E-07	5E-5, 1E-5 ^(b)	3E-5, 8E-6 ^(b)
Total Chronic Hazard Index				
Adult	2E-02	2E-02	2E+0, 2E+0 ^(b)	1E+0, 1E+0 ^(b)
Child	2E-01	2E-01	6E+0, 4E+0 ^(b)	3E+0, 3E+0 ^(b)

Notes:

(a) = Numbers rounded to the nearest integer. Based on reasonable maximum exposure (RME) parameters.

(b) = Results based on the use of groundwater model data

NMCRC-LA = Naval and Marine Corps Reserve Center-Los Angeles
 NA = Not Applicable
 Total = Estimated risk associated with all chemicals of potential concern
 Non-petroleum-related = Estimated risk associated with only those chemicals of potential concern that are not components of petroleum

Table 7-12
Cumulative Risk Analysis
Residential Human Health-Based Soil Reference Values (SRV)

Screening Risk Evaluation based on Residential Land Use Exposure Scenario																	
Chemical	CAS No.	Residential SRV (mg/kg)	Site Concen (mg/kg)	Site HQ (1)	NONCANCER TARGET ENDPOINTS (2)												CANCER (RISK per 100,000) (1)
					ADREN	CV/BLD	CNS/PNS	EYE	IMMUN	KIDN	LIV/GI	PROSTATE	REPRO	RESP	SKIN	SPLEEN	
Inorganics:																	
Chromium	19540-28-9	66	23.1	0.401												7.00E-08 c A	
Cobalt	7440-48-4	2000	23.8	0.001					0.001							NA D	
Nickel	various	520	27.6	0.011	b										0.011	c A	
Vanadium	7440-82-2/1	210	75.3	0.642	b											NA D	
Volatile Organics																	
Acetone	67-64-1	2500	0.113	0.000							0.000					NA D	
Benzene	71-43-2	1.5	0.011	0.000												1.47E-08 A	
n-Butylbenzene	104-51-8	160	0.0031	0.0000000273	c				0.0000000027							NA NA	
sec-Butylbenzene	135-98-8	150	0.0304	0.000					0.000							NA NA	
tert-Butylbenzene (surrogate - n-butylbenzene)	98-06-6	160	0.0663	0.000					0.000							NA NA	
Carbon Disulfide	75-15-0	12	0.00743	0.000	b											NA NA	
1,2-Dichloroethane	107-06-2	3	0.00612	0.000	c											2.04E-08 B2	
Dichloromethane (methylene chloride)	75-09-2	90	0.028	0.000							0.000					3.11E-09 B2	
Ethyl benzene	100-41-4	190	0.427	0.000							0.000					NA D	
Methyl ethyl ketone (2-butanone)	78-93-3	1400	0.0787	0.000							0.000					NA D	
Tetrachloroethylene (PCE)	127-18-4	92	0.001	0.000							0.000					B2/C	
Toluene	108-88-3	145	0.0378	0.000					0.000		0.000					NA NA	
1,2,4-Trimethylbenzene	95-63-6	9	8.02	0.021					0.021		0.000				0.021	D	
1,3,5-Trimethylbenzene	108-67-8	4	0.33	0.001					0.001		0.021				0.001	NA NA	
Xylenes (mixed)	1330-20-7	122	0.913	0.000					0.000		0.001				0.000	NA D	
Polycyclic Aromatic Hydrocarbons																	
Benz[a]anthracene	56-55-3	20	0.14	NA												7.00E-08 B2	
Benz[b]fluoranthene	205-99-2	20	0.29	NA												1.45E-07 B2	
Benz[a]pyrene (or BaP equivalents)	50-32-8	2	0.18	NA												9.00E-07 B2	
Chrysene	218-01-9	2000	0.22	NA												1.10E-09 B2	
Fluoranthene	206-44-0	1080	0.29	0.000	b						0.000					NA D	
Indeno[1,2,3-cd]pyrene	193-39-5	20	0.082	NA	b*						0.000					4.10E-08 B2	
Pyrene	129-00-0	800	0.37	0.000							0.000					NA D	
Polychlorinated Biphenyls																	
PCBs (Polychlorinated Biphenyls)	1336-36-3	0.6	21	7.000	b				7.000	7.000	0.022	0.000	7.000	0.001	0.000	3.50E-05 b B2	
					Cumulative Risk Level (1) =												0.000 0.001 0.022 7.000 7.001 0.022 0.022 0.000 7.000 0.001 0.000 0.033

NOTE: Based on limited multiple pathway exposure scenario (i.e., incidental soil dust ingestion, dermal contact and inhalation).

where multiple contaminants are present, cumulative risk was evaluated.

Soil Reference Values were used as a base mapped against soil concentrations divided by chemical HQ values.

Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ / SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR / SRV).

Individual chemical specific HQ should not exceed 0.2 (see exceptions below, e.g. SRVs set at Csat), cumulative HI should not exceed 1 for each target endpoint.

Cancer risk represents risk per 100,000. Individual as well as cumulative cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

v - considered volatile. Default values of 10% soil moisture, 0.5% soil organic carbon and a 5 acre source area are utilized in Volatilization Model calculations. If site-specific values differ significantly a site-specific re-calculation should be done.

v* indicates that the theoretical soil saturation limit (Csat) is < SRV. Csat concentration represents the concentration above which free-phase liquid contamination may be present.

b Risk based on ingestion and dermal contact only, inhalation pathway could not be included because no inhalation toxicity value was available.

b* indicates that although chemical is a volatile the inhalation pathway could not be quantified, therefore, the SRV will underestimate the risk.

c Risk is based only on inhalation, the ingestion and dermal pathways could not be included because an oral toxicity value was not available.

(1) Site Hazard Quotient (HQ) = Site Exposure Point Conc. x (SRV HQ / SRV). Site ECR = Site Exposure Point Concentration x (SRV ECR / SRV).

Individual chemical specific HQ should not exceed 0.2 (except for explosives), cumulative HI should not exceed 1 for each target endpoint.

Cancer risk represents risk per 100,000. Individual as well as cumulative cancer risk should not exceed 1 per 100,000 (i.e., 1 E-5).

(2) ADREN - adrenal; CVBLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system;

REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN; WHOLE BODY - increased mortality;

decreased growth rate, etc.

Cancer Class:

Class A - Known human carcinogen

Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)

Class C - Possible human carcinogen

Group D - Not Classifiable

Table 7-13
Cumulative Risk Screening
Residential Human Health-Based Soil Reference Values (SRV)

SUMMARY OF TARGET ENDPOINTS RESIDENTIAL LAND USE SOIL REFERENCE VALUE INFORMATION.

Chemical	CAS No	Residential SRV (mg/kg)	Hazard Quotient	Target Organ(s) (1)	Cancer Class	Excess Cancer Risk
Inorganics:						
Aluminum	7429-90-5	30000	0.98	b CNS/PNS; REPROD	NA	NA
Antimony	7440-36-0	14	0.2	CV/BLD; WHOLE BODY	NA	NA
Arsenic	7440-38-2	12	0.2	CV/BLD; CNS/PNS; SKIN; CANCER	A	1E-05
Barium	7440-39-3	2300	0.2	CV/BLD; REPROD	NA	NA
Beryllium	7440-41-7	4	0.01	Not Available; CANCER	B2	1E-05
Boron	7440-42-8	3000	0.2	REPROD; RESP	D	NA
Cadmium	7440-43-9	26	0.2	KIDN; CANCER	B1	6E-08
Chromium III	18065-83-1	24000	0.2	b Not Available	NA	NA
Chromium VI	18540-29-9	66	1.145	Not Available; CANCER	A	2E-07
Cobalt	7440-48-4	2000	0.059	CV/BLD; IMMUN; RESP	D	NA
Copper	7440-50-8	1300	0.2	b LIV/GI	D	NA
Cyanide free	57-12-5	25	1	b CNS/PNS (Note: Based on Acute Intake)	NA	NA
Lead	7439-92-1	400	1	CV/BLD; CNS/PNS; REPROD; CANCER	B2	NA
Manganese	7439-96-5	1100	0.2	CNS/PNS	D	NA
Mercury (methyl mercury)	22967-92-6	3	0.2	b CNS/PNS; REPROD	NA	NA
Mercury (inorganic, elemental and mercuric chloride)	7439-97-6/7487-94-7	0.7	0.2	CNS/PNS; IMMUNE	D	NA
Nickel	various	520	0.205	b WHOLE BODY; CANCER	A	3E-07
Selenium	7782-49-2	174	0.2	b CV/BLD; CNS/PNS; LIV/GI; SKIN	D	NA
Silver	7440-22-4	174	0.2	b SKIN	D	NA
Thallium	various	3	0.2	b CV/BLD; HAIR; REPROD	D	NA
Tin	various	15000	0.2	b KIDN; LIV/GI	D	NA
Vanadium	7440-62-2/1314-62-1	210	1.7	b Not Available	D	NA
Zinc	7440-66-6	10000	0.2	b CV/BLD	D	NA
Volatile Organics						
Acetone	v 67-64-1	2500	0.0000168	CNS/PNS; KIDN; LIV/GI	D	NA
Benzene	v 71-43-2	1.5	0.000545	c CV/BLD; CANCER	A	2E-06
Bromodichloromethane	v 75-27-4	3	0.001	b KIDN; CANCER	B2	1E-05
Bromomethane (methyl bromide)	v 74-83-9	1	0.2	LIV/GI; RESP	D	NA
1,3-Butadiene	v 106-99-0	0.07	NA	CANCER	B2	1E-05
n-Butylbenzene	v 104-51-8	160	4.6-05	CNS/PNS	NA	NA
sec-Butylbenzene	v 135-98-8	150	0.000452	CNS/PNS	NA	NA
tert-Butylbenzene (surrogate - n-butylbenzene)	v 98-06-6	160	4.63E-05	CNS/PNS	NA	NA
Butyl benzylphthalate	85-68-7	5800	0.2	b GI/LIV	C	NA
Carbon Disulfide	v 75-15-0	12	1.59E-08	b CNS/PNS; REPROD (Note: Based on Acute Intake)	NA	NA
Carbon Tetrachloride	v 56-23-5	0.3	0.2	LIV/GI; CANCER	B2	1E-06
Chlorobenzene	v 108-90-7	11	0.2	KIDN; LIV/GI	D	NA
Chloroethane (ethyl chloride)	v 75-00-3	400	0.2	REPROD	NA	NA
Chloroform (trichloromethane)	v 67-66-3	2.5	0.07	LIV/GI; CANCER	B2	1E-05
Chloromethane (methyl chloride)	v 74-87-3	13	0.04	WHOLE BODY; CANCER (?)	C	1E-05
2-Chlorotoluene	v 95-49-8	436	0.13	b WHOLE BODY (Note: Csat Utilized)	NA	NA
Cumene (isopropylbenzene)	v 98-82-8	135	0.2	ADRENAL; KIDN	NA	NA
1,2-Dibromomethane (ethylene dibromide)	v 106-93-4	0.14	0.2	c REPROD; CANCER	B2	1E-05
Volatile Organics						
Dibromomethane (methylene bromide)	v 74-95-3	300	0.2	b CV/BLD	NA	NA
Dichlorodifluoromethane (Freon 12)	v 75-71-8	16	0.2	LIV/GI; WHOLE BODY	NA	NA
1,1-Dichloroethane	v 75-34-3	30	0.07	KIDN; CANCER (?)	C	1E-05
1,2-Dichloroethane	v 107-06-2	3	3.04E-05	c NA; CANCER	B2	1E-05
1,1-Dichloroethylene	v 75-35-4	0.4	0.0003	b LIV/GI; CANCER (?)	C	1E-05
cis-1,2-Dichloroethylene	v 154-59-2	320	0.2	b CV/BLD	D	NA
trans-1,2-Dichloroethylene	v 156-60-5	130	0.2	LIV/GI	D	NA
1,2-Dichloroethylene (mixed isomers)	v 540-59-0	105	0.2	LIV/GI	D	NA
Dichloromethane (methylene chloride)	v 75-09-2	90	6.94E-05	LIV/GI; CANCER	B2	1E-05
1,2-Dichloropropane	v 78-87-5	3.5	0.14	RESP; CANCER	B2	1E-05
Ethyl benzene	v 100-41-4	190	0.000635	KIDN; LIV/GI; REPROD (Note: Csat utilized)	D	NA
Methyl ethyl ketone (2-butanone)	v 78-93-3	1400	1.95E-05	REPROD	D	NA
Methyl isobutyl ketone (MIBK)	v 108-10-1	140	0.2	KID; LIV/GI; WHOLE BODY	NA	NA
Naphthalene	v 91-20-3	2	0.0026	CV/BLD; EYE; RESP	D	NA
n-Propylbenzene (surrogate - Cumene)	v 103-65-1	135	9.34E-05	ADRENAL; KIDN	NA	NA
Styrene	v 100-42-5	210	0.06	CV/BLD; CNS/PNS; LIV/GI; CANCER	B2	1E-05
1,1,1,2-Tetrachloroethane	v 630-20-6	26	0.01	b KIDN; LIV/GI; CANCER (?)	C	1E-05
1,1,2,2-Tetrachloroethane	v 79-34-5	4	0.2	b LIV/GI; WHOLE BODY; CANCER (?)	C	8E-06
Tetrachloroethylene (PCE)	v 127-18-4	92	1.45E-05	CNS/PNS; KIDN; LIV/GI; CANCER	B2/C	3E-06
Toluene	v 108-88-3	145	2.81E-05	CNS/PNS; KIDN; LIV/GI; RESP	D	NA
1,2,4-Trichlorobenzene	v 120-82-1	230	0.2	ADREN; LIV/GI	D	NA
1,1,1-Trichloroethane	v 71-55-6	310	0.2	CNS/PNS; LIV/GI	D	NA
1,1,2-Trichloroethane	v 79-00-5	7	0.01	b CV/BLD; IMMUNE; LIV/GI; CANCER (?)	C	1E-05
Trichloroethylene (TCE)	v 79-01-6	34	NA	CANCER	B2/C	1E-05

Table 7-13
Cumulative Risk Screening
Residential Human Health-Based Soil Reference Values (SRV)

Chemical	CAS No	Residential SRV (mg/kg)	Hazard Quotient	Target Organ(s) (1)	Cancer Class	Excess Cancer Risk
Volatile Organics						
Trichlorofluoromethane	v 75-69-4	67	0.2	WHOLE BODY	NA	NA
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	v ¹ 76-13-1	1485	1	CNS/PNS: WHOLE BODY (Note: Csat utilized)	NA	NA
1,2,4-Trimethylbenzene	v 95-63-6	9	0.0238	CNS/PNS; KIDN; LIV/GI; WHOLE BODY	NA	NA
1,3,5-Trimethylbenzene	v 108-67-8	4	0.00276	CNS/PNS; KIDN; LIV/GI; WHOLE BODY	NA	NA
Vinyl chloride	v 75-01-4	0.2	0.06	b ¹ LIV/GI; CANCER	A	1E-05
Xylenes (mixed)	v 1330-20-7	122	6.78E-05	CNS/PNS: RESP; WHOLE BODY	D	NA
Non/Semi Volatile Organics						
Benzyl alcohol	100-51-6	8700	0.2	b LIV/GI	NA	NA
Bis (2-chloroethyl) ether	v 111-44-4	0.5	NA	CANCER	B2	1E-05
Bis (chloromethyl) ether	v 542-88-1	0.002	NA	CANCER	A	1E-05
Bromoform (tribromomethane)	75-25-2	570	0.2	b LIV/GI; CANCER	B2	3E-06
Butyl benzylphthalate	85-68-7	5800	0.2	b LIV/GI	C	NA
Dibenzofuran	v 132-84-9	120	0.2	b ¹ KIDN	NA	NA
1,4-Dibromobenzene	106-37-6	285	0.2	b LIV/GI	NA	NA
Dibromochloromethane	124-48-1	170	0.06	b LIV/GI; CANCER (?)	C	1E-05
Dibutyl phthalate	84-74-2	2800	0.2	b WHOLE BODY	D	NA
1,2-Dichlorobenzene	v 95-50-1	195	0.2	WHOLE BODY	D	NA
1,3-Dichlorobenzene	v 541-73-1	180	0.2	WHOLE BODY	D	NA
1,4-Dichlorobenzene	v 106-46-7	30	0.01	c KIDN; LIV/GI; CANCER (?)	C	1E-05
3,3'-Dichlorobenzidine	91-94-1	35	NA	CANCER	B2	1E-05
2,4-Dichlorophenol	120-83-2	70	0.2	b IMMUNE	NA	NA
Di(2-ethylhexyl)phthalate (bis-ethylhexyl phthalate)	117-81-7	625	0.2	b LIV/GI; CANCER	B2	5E-06
2,4-Dimethylphenol	105-67-9	600	0.2	b CV/BLD; CNS/PNS	NA	NA
Di-n-octyl phthalate	117-84-0	570	0.2	b KIDN; LIV/GI	NA	NA
2-Methylphenol (o-cresol)	95-48-7	60	1	b CNS/PNS; WHOLE BODY; CANCER (?) (Note: SRV based on Acute Intake)	C	NA
3-Methylphenol (m-cresol)	108-39-4	60	1	b CNS/PNS; WHOLE BODY; CANCER (?) (Note: SRV based on Acute Intake)	C	NA
4-Methylphenol (p-cresol)	106-44-5	60	1	b CNS/PNS; RESP; CANCER (?) (Note: SRV based on Acute Intake)	C	NA
N-Nitrosodiphenylamine	88-30-6	3000	NA	CANCER	B2	1E-05
N-Nitrosodi-N-propylamine	621-64-7	2.2	NA	CANCER	B2	1E-05
Pentachlorophenol	87-86-5	85	0.03	KIDN; LIV/GI; CANCER	B2	1E-05
Phenol	108-95-2	1700	1	b REPRO (Note: SRV based on Acute Intake)	D	NA
2,3,4,6-Tetrachlorophenol	58-90-2	700	0.2	b LIV/GI	NA	NA
2,4,5-Trichlorophenol	95-95-4	2300	0.2	b KIDN; LIV/GI	NA	NA
2,4,6-Trichlorophenol	88-06-2	1100	NA	CANCER	B2	1E-05
Polyaromatic Hydrocarbons						
Acenaphthene	v ¹ 83-32-9	90	NA	b ¹ LIV/GI (Note: Csat utilized)	NA	NA
Anthracene	v ¹ 120-12-7	5	NA	b ¹ NOT AVAILABLE (Note: Csat utilized)	D	NA
Benz[a]anthracene	56-55-3	20	NA	CANCER	B2	1E-05
Benzo[b]fluoranthene	205-99-2	20	NA	CANCER	B2	1E-05
Benzo[k]fluoranthene	207-08-9	200	NA	CANCER	B2	1E-05
Benzo[a]pyrene (or BaP equivalents)	50-32-8	2	NA	CANCER	B2	1E-05
Chrysene	218-01-9	2000	NA	CANCER	B2	1E-05
Dibenz[ah]anthracene	53-70-3	2	NA	CANCER	B2	1E-05
Fluoranthene	206-44-0	1080	0.00109	b CV/BLD; KIDN; LIV/GI	D	NA
Fluorene	v 86-73-7	1140	0.2	b ¹ CV/BLD	D	NA
Indeno[1,2,3-cd]pyrene	193-39-5	20	NA	CANCER	B2	1E-05
Naphthalene - see Volatile Organics						
Pyrene	v 129-00-0	800	0.001835	b ¹ KIDN	D	NA
Quinoline	91-22-5	1	NA	CANCER (?)	C	1E-05
Polychlorinated Biphenyls						
PCBs (Polychlorinated Biphenyls)	1336-36-3	0.6	0.2	b EYE; IMMUNE; REPROD; CANCER	B2	1E-05
MDA Pesticides and Herbicides						
Aldrin	309-00-2	1	0.2	b LIV/GI; CANCER	B2	1E-05
2,4-Dichlorophenoxyacetic acid (2,4-D)	94-75-7	300	0.2	b CV/BLD; KIDN; LIV/GI	NA	NA
4-(2,4-Dichlorophenoxy) butyric acid (2,4-DB)	94-82-6	260	0.2	b CV/BLD; LIV/GI; WHOLE BODY	NA	NA
2-Methyl-4-chlorophenoxyacetic acid (MCPA)	94-75-6	16	0.2	b KIDN; LIV/GI	NA	NA
2-(2-Methyl-4-chlorophenoxy)propionic acid (MCPP)	93-65-2	32	0.2	b KIDN	NA	NA
Metolachlor	51218-45-2	5000	0.2	b WHOLE BODY; CANCER (?)	C	NA
Picloram	1919-02-1	2200	0.2	b LIV/GI	NA	NA
Terbufos	13071-79-9	0.6	0.2	b CNS/PNS	NA	NA
2,4,5-Trichlorophenoxyacetic acid (2,4,5-T)	93-76-5	320	0.2	b KIDN; REPRO	NA	NA

Table 7-13
Cumulative Risk Screening
Residential Human Health-Based Soil Reference Values (SRV)

Chemical	CAS No	Residential SRV (mg/kg)	Hazard Quotient	Target Organ(s) (1)	Cancer Class	Excess Cancer Risk	
Dioxins and Furans							
2,3,7,8-TCDD (or 2,3,7,8-TCDD equivalents)	1746-01-6	0.0002	NA	IMMUNE; REPROD; CANCER	B2	1E-05	
1,2,3,7,8-PeCDD		0.0004	NA	IMMUNE; REPROD; CANCER	B2	1E-05	
1,2,3,4,7,8-HxCDD		0.002	NA	IMMUNE; REPROD; CANCER	B2	1E-05	
1,2,3,6,7,8-HxCDD		0.002	NA	IMMUNE; REPROD; CANCER	B2	1E-05	
1,2,3,7,8,9-HxCDD		0.002	NA	IMMUNE; REPROD; CANCER	B2	1E-05	
1,2,3,4,6,7,8-HpCDD		0.02	NA	IMMUNE; REPROD; CANCER	B2	1E-05	
1,2,3,4,6,7,8,9-OCDD		0.2	NA	IMMUNE; REPROD; CANCER	B2	1E-05	
2,3,7,8-TCDF		0.002	NA	IMMUNE; REPROD; CANCER	B2	1E-05	
1,2,3,7,8-PeCDF		0.004	NA	IMMUNE; REPROD; CANCER	B2	1E-05	
2,3,4,7,8-PeCDF		0.0004	NA	IMMUNE; REPROD; CANCER	B2	1E-05	
1,2,3,4,7,8-HxCDF		0.002	NA	IMMUNE; REPROD; CANCER	B2	1E-05	
1,2,3,6,7,8-HxCDF		0.002	NA	IMMUNE; REPROD; CANCER	B2	1E-05	
2,3,4,6,7,8-HxCDF		0.002	NA	IMMUNE; REPROD; CANCER	B2	1E-05	
1,2,3,7,8,9-HxCDF		0.002	NA	IMMUNE; REPROD; CANCER	B2	1E-05	
1,2,3,4,6,7,8-HpCDF		0.02	NA	IMMUNE; REPROD; CANCER	B2	1E-05	
1,2,3,4,7,8,9-HpCDF		0.02	NA	IMMUNE; REPROD; CANCER	B2	1E-05	
1,2,3,4,6,7,8,9-OCDF		0.2	NA	IMMUNE; REPROD; CANCER	B2	1E-05	
Explosives							
1,3 - DNB	99-65-0	2	0.2	b SPLEEN	D	NA	
2,4 - DNT	121-14-2	55	0.2	b CV/BLD; CNS/PNS; LIV/GI; CANCER	see mixture below		
2,6 - DNT	606-20-2	30	0.2	b CV/BLD; CNS/PNS; KID; LIV/GI; CANCER	see mixture below		
2,4- AND 2,6 DNT MIXTURE		22	NA	CANCER	B2	1E-05	b
HMX	2691-41-0	1500	0.2	b LIV/GI	D	NA	
RDX	121-82-4	40	0.2	b PROSTATE; CANCER (?)	C	1E-05	b
1,3,5 - TNB	99-35-4	1	0.2	b SPLEEN	NA	NA	
2,4,6 - TNT	118-96-7	11	0.2	b LIVER; CANCER (?)	C	3E-07	b
Other Organics							
Benzoic acid	65-85-0	100000	0.17	b NA (Note: Soil Maximum Utilized)	D	NA	
Hexane	v 110-54-3	10	0.2	CNS/PNS; REPRO; RESP	NA	NA	
Additional Pesticides and Herbicides							
gamma-BHC (Lindane)	58-89-9	9	0.2	b KIDN; LIV/GI; CANCER	B2/C	8E-06	b
Chloramben	133-90-4	480	0.2	b LIV/GI	NA	NA	
Chlordane	57-74-9	2	0.2	LIV/GI; CANCER	B2	2E-05	
4,4' - DDD	75-54-8	70	NA	CANCER	B2	1E-05	b
4,4' - DDE	72-55-9	50	NA	CANCER	B2	1E-05	b
4,4' - DDT	50-29-3	15	0.2	b LIV/GI; CANCER	B2	3E-06	
Diazinon	333-41-5	30	0.2	b CNS/PNS	NA	NA	
Dieldrin	60-57-1	1	0.12	b LIV/GI; CANCER	B2	1E-05	
Endosulfan	115-29-7	135	0.2	b CV/BLD; CNS/PNS; KIDN	NA	NA	
Endrin	72-20-8	10	0.2	b CNS/PNS; LIV/GI	D	NA	
Heptachlor	76-44-8	4	0.05	b LIV/GI; CANCER	B2	1E-05	
Heptachlor epoxide	1024-57-3	0.4	0.2	b LIV/GI; CANCER	B2	2E-06	
Methoxychlor	72-43-5	125	0.2	b REPROD	D	NA	
Toxaphene	8001-35-2	16	NA	CANCER	B2	1E-05	

NOTE: Based on limited multiple pathway exposure scenario (i.e., incidental soil/dust ingestion, dermal contact and inhalation)

v - considered volatile. Default values of 10% soil moisture, 0.5% soil organic carbon and a 5 acre source area are utilized in Volatilization Model calculations. If site-specific values differ significantly a site-specific re-calculation should be done.

v^h indicates that the theoretical soil saturation limit (C_{sat}) is < SRV. C_{sat} concentration represents the concentration above which free-phase liquid contamination may be present.

b Risk based on ingestion and dermal contact only. Inhalation pathway could not be included because no inhalation toxicity value was available.

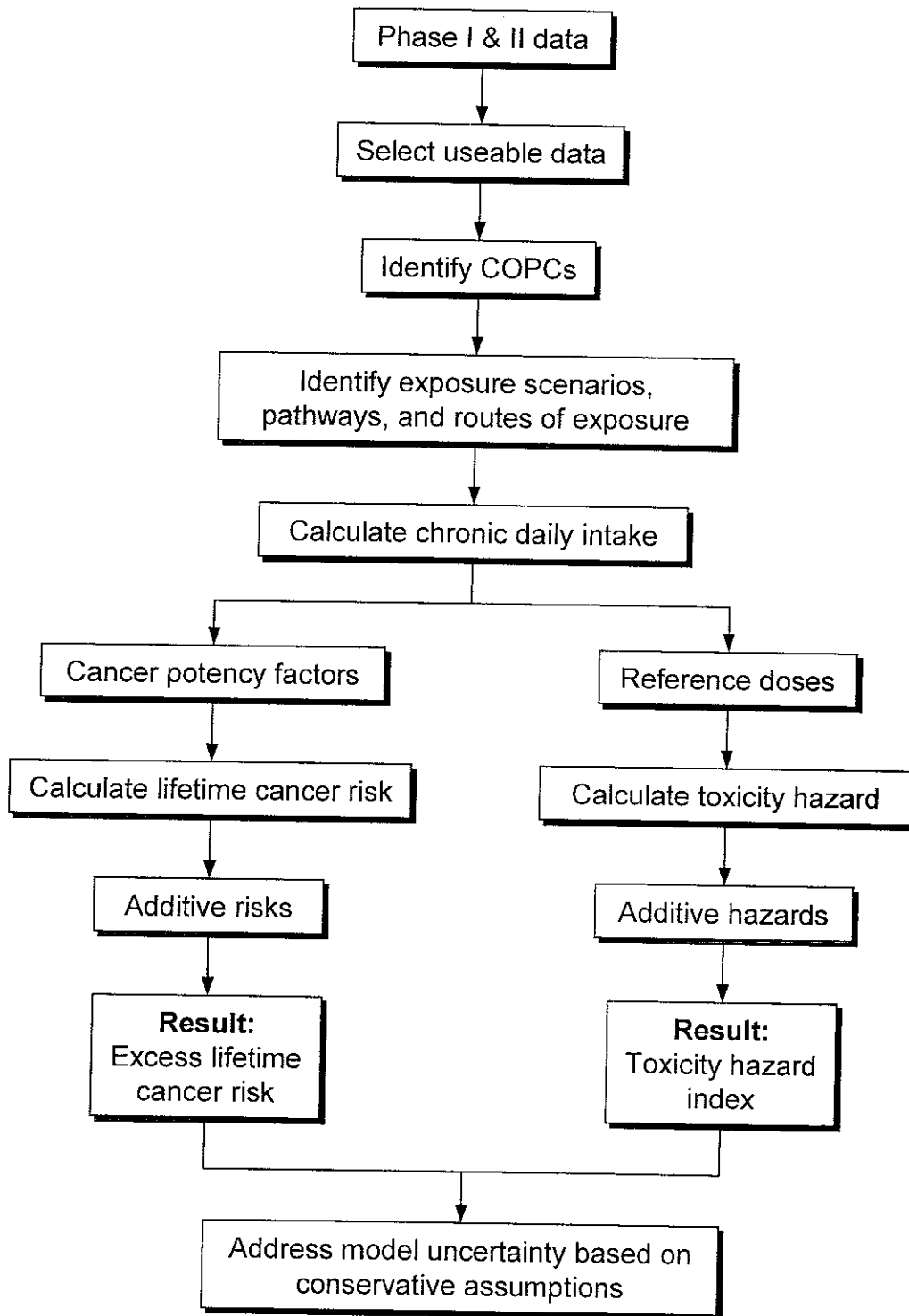
b indicates that although chemical is a volatile the inhalation pathway could not be quantified, therefore the SRV will underestimate the risk.

c Risk is based only on inhalation. The ingestion and dermal pathways could not be included because an oral toxicity value was not available.

(1) ADREN - adrenal; CV/BLD - cardiovascular/blood system; CNS/PNS - central/peripheral nervous system; EYE - immune system; KIDN - kidney; LIV/GI - liver/gastrointestinal system; REPRO - reproductive system (incl. teratogenic/developmental effects); RESP - respiratory system; SKIN - skin irritation or other effects; SPLEEN - WHOLE BODY - increased mortality, decreased growth rate, etc.

Cancer Class:
 Class A - Known human carcinogen
 Class B - Probable human carcinogen (B1 - limited evidence in humans; B2 - inadequate evidence in humans but adequate in animals)
 Class C - Possible human carcinogen
 Group D - Not Classifiable

Figure 7-1
Risk Assessment Process Flow Diagram



8.0 CONCLUSIONS AND RECOMENDATIONS

This section summarizes the information gathered during the SI, provides conclusions based on this information, then makes a recommendation.

8.1 CONCLUSIONS

Absence of Former Gasoline UST. The geophysical survey, using ground penetrating radar, metal detection, and electromagnetic detection, did not find evidence of a UST still in place below the ground surface. It is likely that the UST was removed prior to the mid-1980s as previously reported.

Hydrogeology. Groundwater was encountered at approximately 27 to 35 feet bgs at the site. The groundwater gradient based on potentiometric elevation measurements is to the south-southeast. General groundwater quality indicates it is not very suitable for use as drinking water.

Sampling Program. A total of 45 soil samples were analyzed for key contaminants of concern. An additional 24 soil samples were collected for metals analysis to characterize background metals levels. Soil samples were collected at depths from 5 to 25 feet bgs.

Seven groundwater monitoring wells were installed at the NMCRC-LA site. An additional seven groundwater grab samples were collected from temporary screened piezometers that were installed following soil sampling from borings.

Nature of Contamination. The type of contaminants identified in soil and groundwater consisted primarily of petroleum hydrocarbons. Total petroleum hydrocarbons (TPH) in the gasoline range and, to a lesser degree, in the diesel and motor oil range, were detected. Benzene, toluene, ethylbenzene, and xylenes (BTEX) were several of the fuel analytes detected

in soil samples, along with 1,2,4-trimethylbenzene (TMB) and 1,3,5-TMB, naphthalene, and 2-methylnaphthalene. All of these analytes are components of gasoline. Methyl-tertiary-butyl-ether (MTBE) was not detected.

1,2-DCA was also detected in soil and groundwater samples. 1,2-DCA was historically used as a gasoline additive. The absence of other chlorinated hydrocarbons such as trichloroethylene (TCE) suggests that 1,2-DCA was most likely detected at this site as a result of fuel use, rather than solvent use.

PCBs were detected in soil samples (although below screening criteria) beneath the vehicle maintenance building during Phase I sampling. Additional soil samples were collected at locations 20 feet away during Phase II, but PCBs were not detected in these samples, indicating a limited extent of PCBs. PCBs were not detected in groundwater during either phase.

Metals were detected in most soil samples and many groundwater samples, although many results were likely representative of background metals concentrations. Certain metals that were considered as possibly slightly above background levels, based on site-specific background metals assessment, were included in the HHRA. These metals were chromium, cobalt, molybdenum, nickel, and vanadium for soil and antimony, barium, cobalt, lead, molybdenum, nickel, and zinc for groundwater. Organic lead was not detected in any samples from this site.

Extent of Contamination. The concentrations in soil and groundwater were highest where the gasoline UST is suspected to have been located (between the lube rack and vehicle maintenance building). Lower or nondetect concentrations were detected at locations more distant from the source area.

Concentrations of analytes that are relatively highly degradable, such as benzene, were identified in groundwater near the source area and at lesser concentrations a short distance away. Concentrations of analytes that are less degradable, such as TMBs, were identified in groundwater at a greater distance away from the source area. The analyte 1,2-DCA, which is more recalcitrant than non-chlorinated petroleum hydrocarbons, was detected in groundwater further downgradient from the source area.

Screening Criteria. Soil and groundwater sample results were compared to screening criteria, which consisted of conservative residential United States Environmental Protection Agency (EPA) Region IX preliminary remediation goals (PRGs) for soil and EPA maximum contaminant levels (MCLs) for groundwater (or PRGs, if MCLs do not exist for an analyte for groundwater). Because the maximum concentration of at least one analyte exceeded screening criteria for both soil and groundwater, additional data analysis was conducted. The purpose was to assess the fate and transport of contaminants and to more accurately assess the magnitude of potential impacts to human health that might be posed by site contamination.

Fate and Transport of Contaminants. To support the HHRA, the fate and transport of contaminants in both soil and groundwater were assessed. The assessment provided an estimate of the degradation of petroleum hydrocarbon contaminants that naturally occurs with compounds such as gasoline, as well as estimated concentrations of analytes in groundwater that might exceed beyond the NMCRC-LA property boundary in the future.

The results of the fate and transport assessment indicate that residual concentrations of indicator chemicals (e.g., benzene, TMBs, 1,2-DCA, naphthalene, and lead) that were assessed are present in soils at sufficient concentrations to continue to act as a source of contamination to groundwater. Concentrations in groundwater are likely to remain near their current concentration for some time into the future due to this ongoing residual source. The fuel-related hydrocarbons are likely undergoing significant degradation by natural biological processes at the site, limiting the mobility of these compounds. These fuel compounds have

likely reached a steady state and will not likely migrate significantly in the future unless pavement is removed and rainfall infiltration increases. The 1,2-DCA is less degradable due to the presence of abundant sulfate in the groundwater. The fate and transport of lead was evaluated and the results indicate it is almost immobile due to its high degree of sorption onto the soil matrix.

Human Health Risk Assessment. Human health risk was assessed following EPA and State of California Department of Toxic Substances Control (DTSC) guidelines. The source area of contamination was located several feet underground, and no drinking water wells are located in the area. Because the site is paved with asphalt or concrete no human receptor exposure pathways are considered to exist at the current time. However, future changes in site characteristics or use, such as installation of drinking water wells, removal of pavement, or industrial or residential development could possibly lead to potential exposure of humans to identified site contaminants.

The future scenarios for potential human exposure included in the human health risk assessment for this site are the following:

- Exposure of construction workers to site contaminants through incidental soil ingestion, dermal contact with soil, and inhalation of particulates and volatile organic compounds (VOCs). This might occur during activities such as excavation of soil during construction of a building foundation;
- Industrial exposure to site contaminants through incidental soil ingestion, dermal contact with soil, and inhalation of particulates and VOCs. This scenario would require removal of the pavement covering the site and industrial development of the site;
- Residential exposure to site contaminants through incidental soil ingestion, dermal contact with soil, and inhalation of particulates and VOCs. This scenario would require removal of the pavement covering the site and residential development of the site; and
- Residential exposure to site contaminants in groundwater. This scenario would require installation of groundwater wells for domestic use in the contaminated plume or in a downgradient area potentially impacted by the plume. This could

result in exposure to contaminants in groundwater through ingestion, inhalation (i.e., vaporization of volatile contaminants during showering), and dermal exposure (i.e., skin contact during showering).

These scenarios are considered unlikely to occur due to the likely future use of the site. Evaluation of these scenarios for potential impacts to human health was performed to provide a health protective estimate of the potential future risks presented by site contamination.

The results of the HHRA indicate that soil contamination does not present an unacceptable risk to human health under the future scenarios assessed. If a drinking water well were to be installed just off the NMCRC-LA property, exposure to groundwater contaminants could possibly present a risk to human health under a future residential scenario. The majority of calculated risk is associated with groundwater that might be consumed and inhalation of vapors during showering.

These HHRA results are based on conservative assumptions and could easily be three orders of magnitude lower if evaluated using more realistic parameters. This approach was introduced to error on the side of conservatism. The risk assessment results should be evaluated with an understanding of the following qualifiers to better understand the conservative estimates of potential risk and hazard that could be posed by exposure to groundwater contaminants:

- It is unlikely that a drinking water well would be installed directly adjacent to the NMCRC-LA property line where contaminants might migrate offsite.
- The groundwater beneath the site is not very suitable for drinking purposes due to its high total dissolved solids (TDS), chloride, and sulfate concentrations. In addition, site data indicate that groundwater might not be able to be pumped at a rate high enough (e.g., 3 gallons per minute) for a well to be successfully used.
- Sample collection from the NMCRC-LA site was biased towards areas of contamination, which increased the average contaminant concentration used in the risk assessment calculations;
- Fate and transport modeling calculations were very conservative and produced conservative results that were used in the risk assessment future scenario. For

example, (1) vadose zone modeling assumed that biodegradation does not take place (because it is a simple model), but biodegradation of organic contaminants in soil would reduce the calculated future groundwater concentrations, (2) the modeling did not include effects of dispersion, although dispersion would reduce calculated concentrations, (3) the modeling did not include the loss of VOCs from groundwater via volatilization, although volatilization would reduce calculated concentrations, and (4) a maximum leachate rate was used, although a lower leachate rate would reduce calculated concentrations.

- The worse-case groundwater modeling results were used in the risk assessment (i.e., maximum precipitation recharge, assuming that pavement is removed from the site in the future). Assuming pavement is not removed would decrease calculated risk.
- Several metals were considered to exist onsite above background levels, as identified by a site-specific background metals analysis, so these were included in the risk assessment. It is possible they might not be site contaminants because metals are not present in gasoline at high concentrations. Metals concentrations at the property boundary were assumed to be the same concentration as in the source area, although metals generally have extremely limited mobility, as shown by modeling results for lead.
- Chloroform detected in groundwater adds to the calculated excess cancer risk, but is not a chemical that was a suspected site contaminant from the gasoline UST at this site. It was detected at the highest concentrations at the two upgradient background groundwater sampling locations, as well as at lower concentrations beneath the vehicle maintenance building. It was not detected in groundwater adjacent to the source area or downgradient. Chloroform is a Trihalomethane that is produced during chlorination of drinking water and could possibly have been detected in groundwater at the site at the concentrations detected (up to 10 $\mu\text{g/L}$) as a result of leaks from subsurface drinking water pipes near the administration building.
- Toxicity values derived from animal studies at high doses have large safety factors built into them (e.g., factors of 100) to err on the side of conservatism;
- Use of upper-bound exposure assumption values carried through multiple calculations propagates the conservatism of the resulting calculations;
- In addition to the level of conservatism added by each of the factors identified above, the HHRA used a reasonable maximal exposure (RME) in the risk assessment calculations, which produces higher estimates of risk than more realistic or average case scenarios.

8.2 RECOMMENDATIONS

Based on results presented in this report and summarized in Section 8, CDM Federal recommends that the site no longer be considered a CERCLA IR site, but should fall under the State of California's Leaking Underground Fuel Tank Program. CDM Federal also recommends quarterly groundwater sampling and analysis for the contaminants of concern be conducted for two years. This would allow an assessment of whether site contaminants in groundwater appear to be decreasing in concentration over time, appear to be remaining stable, or are increasing. If groundwater contaminant concentrations are not increasing, the Navy should request that DTSC officially close this site with no further action required.

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Appendix A
Geophysical Survey Report

S P E C T R U M



Results of Geophysical Investigation

Naval & Marine Corps Center
1700 Stadium Way
Los Angeles, CA

Prepared for: CDM Federal
Golden, Colorado

Date of Investigation: October 27, 1999

Prepared by:

Charles Carter

Charles Carter
Project Manager
Spectrum Geophysics
622 Glenoaks Blvd
San Fernando, CA 91340



Warranty:

Spectrum Geophysics was retained to conduct a geophysical investigation of the above facility to characterize the shallow subsurface. Our findings are subject to certain limitations due to site conditions and the instruments employed. We conducted this investigation in a manner consistent with our profession using similar methods. No other warranty as to the performance or deliverables is expressed or implied.

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Introduction

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Results and Conclusions

Figure 1 Area of Geophysical Investigation,
 Naval & Marine Corps Center, 1700
 Stadium Way, Los Angeles,
 California

Figure 2 Contour Map of EM-61 Differential,
 Naval & Marine Corps Center, 1700
 Stadium Way, Los Angeles,
 California

**Results of Geophysical Investigation
Naval & Marine Corps Center
1700 Stadium Way
Los Angeles, California**

Introduction

On October 27, 1999 Spectrum Geophysics conducted a geophysical investigation at the Naval & Marine Corps Center located at 1700 Stadium Way in Los Angeles, California. The purpose of the investigation was to locate detectable underground storage tanks (USTs). The area of interest, as designated by Dave Bjostad and Matt Brookshire of CDM Federal, had approximate dimensions of 60 feet by 55 feet (Figure 1).

Methods

The equipment used in this investigation consisted of a GSSI SIR-3 ground penetrating radar (GPR) coupled to a 500 MHz antenna, Geonics EM-61 high-sensitivity metal detector, and a Fisher M-scope metal detector.

The GPR sends an electromagnetic pulse from the transmitting section of the antenna into the ground. When this pulse reaches the interface of mediums with contrasting dielectric properties, a portion of this pulse is reflected back to the receiving portion the antenna. The GPR unit then processes this information and displays it in the form of a vertical cross section. Because the dielectric properties of soil and a steel UST are significantly different, the GPR is well suited for a survey of this kind if GPR depth of penetration is deep enough. The depth of penetration at this sight is estimated to be six to seven feet at best. A total of thirteen GPR traverses were collected. The locations of these traverses are indicated in Figure 1.

The EM-61 was used in an effort to delineate areas in which large metallic objects may be buried. However, this instrument was not used in areas with reinforced concrete to avoid acquiring "noisy" data. The EM-61 transmitter generates short pulses of electromagnetic energy which travel downward and outward and have a primary field associated with them. This energy becomes "trapped" in the conductive materials and causes a secondary magnetic field to be generated in these materials. The receiver measures the voltage of the decay curve of this secondary magnetic field, which is proportional to the conductivity of the subsurface materials. EM-61 voltage readings were taken, recorded, and stored in a digital

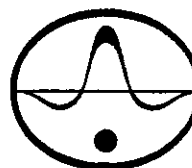
polycorder at 5-foot intervals along north-south lines spaced 5 feet apart within a grid established by the geophysics crew. These data were processed in the field and used to generate a contour map to identify anomalies that may be caused by the presence of USTs.

Results and Conclusions

A site map with geophysical interpretation is presented in Figure 1, and a contour map of EM-61 differential is presented in Figure 2. No UST-like anomalies were observed in the data. One backfilled excavation was identified. The location of this anomaly is indicated in Figure 1. It must be mentioned that access was limited in areas occupied by workbenches and pallets (Figure 1) and thus it could not be determined whether a UST was present in these areas.

Spectrum does not guarantee that all existing piping and features have been identified during this investigation.

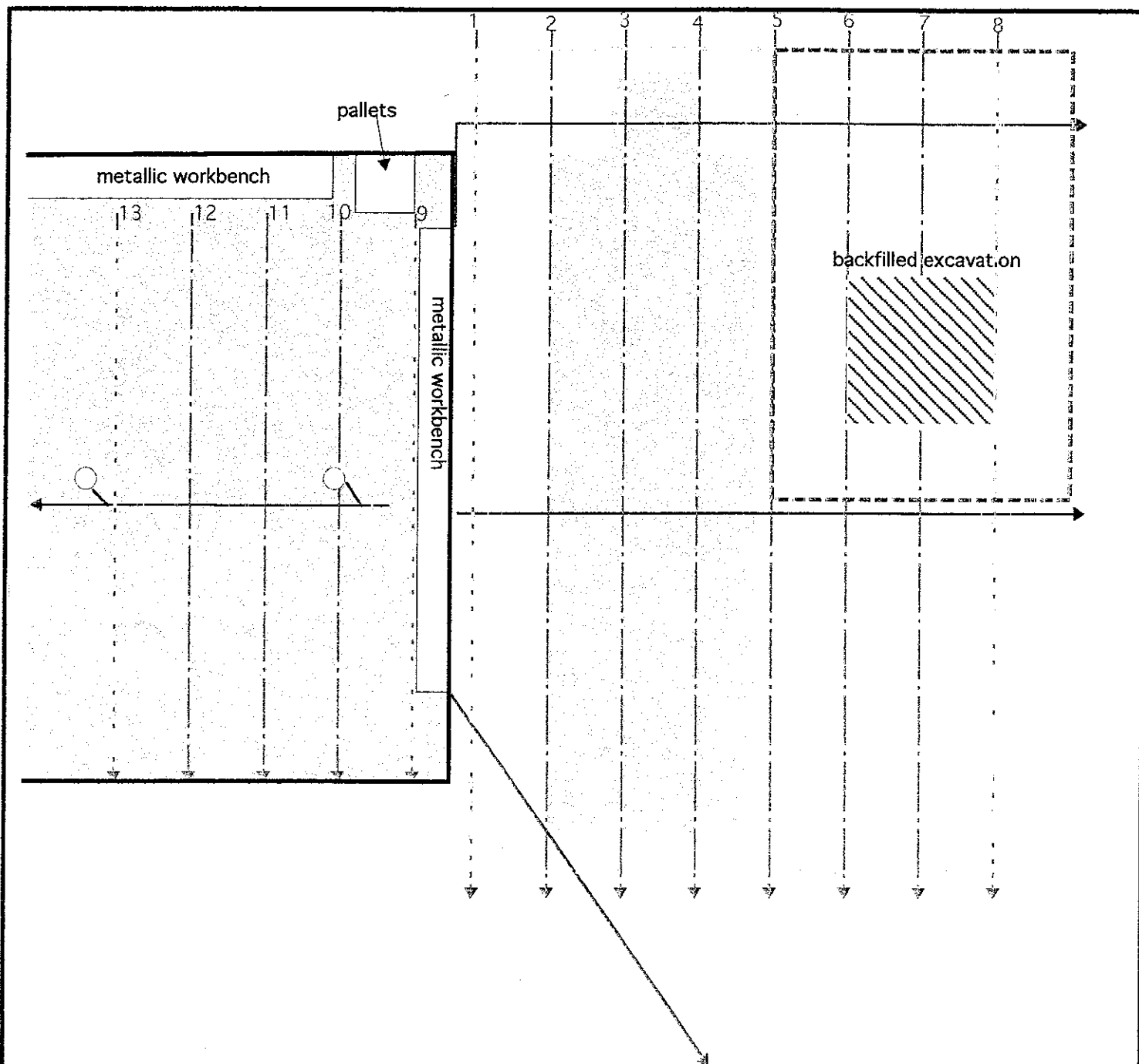
FIGURE 1
 AREA OF GEOPHYSICAL INVESTIGATION
 NAVAL & MARINE CORPS CENTER
 1700 STADIUM WAY
 LOS ANGELES, CALIFORNIA



SPECTRUM

GEOPHYSICS

622 Glenoaks Blvd.,
 San Fernando, CA 91340

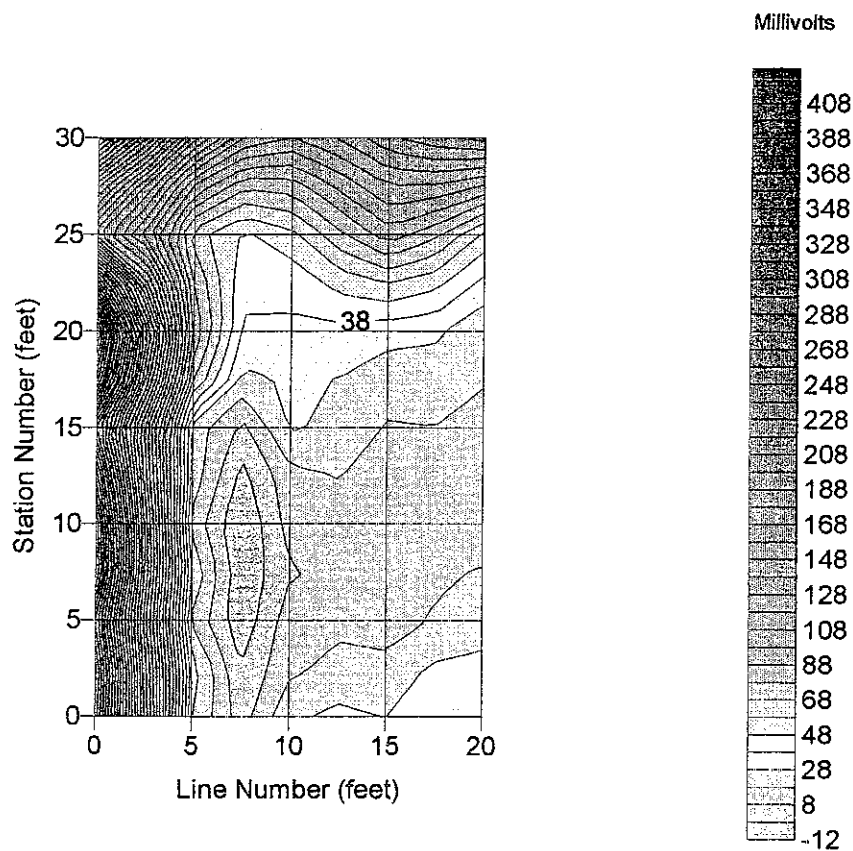


EXPLANATION

Area of geophysical investigation Area of EM-61 investigation GPR traverse with number Reinforced concrete	Water line Electric line Drain line	N 0 5 10 One inch equals approximately 10 feet	Project Number: 9910271M Date of Investigation: October 27, 1999 Map by C. Carter
Not all below ground facilities may be represented on this map			

Figure 2: Contour Map of EM-61 Differential

Naval & Marine Corps Center
1700 Stadium Way
Los Angeles, California

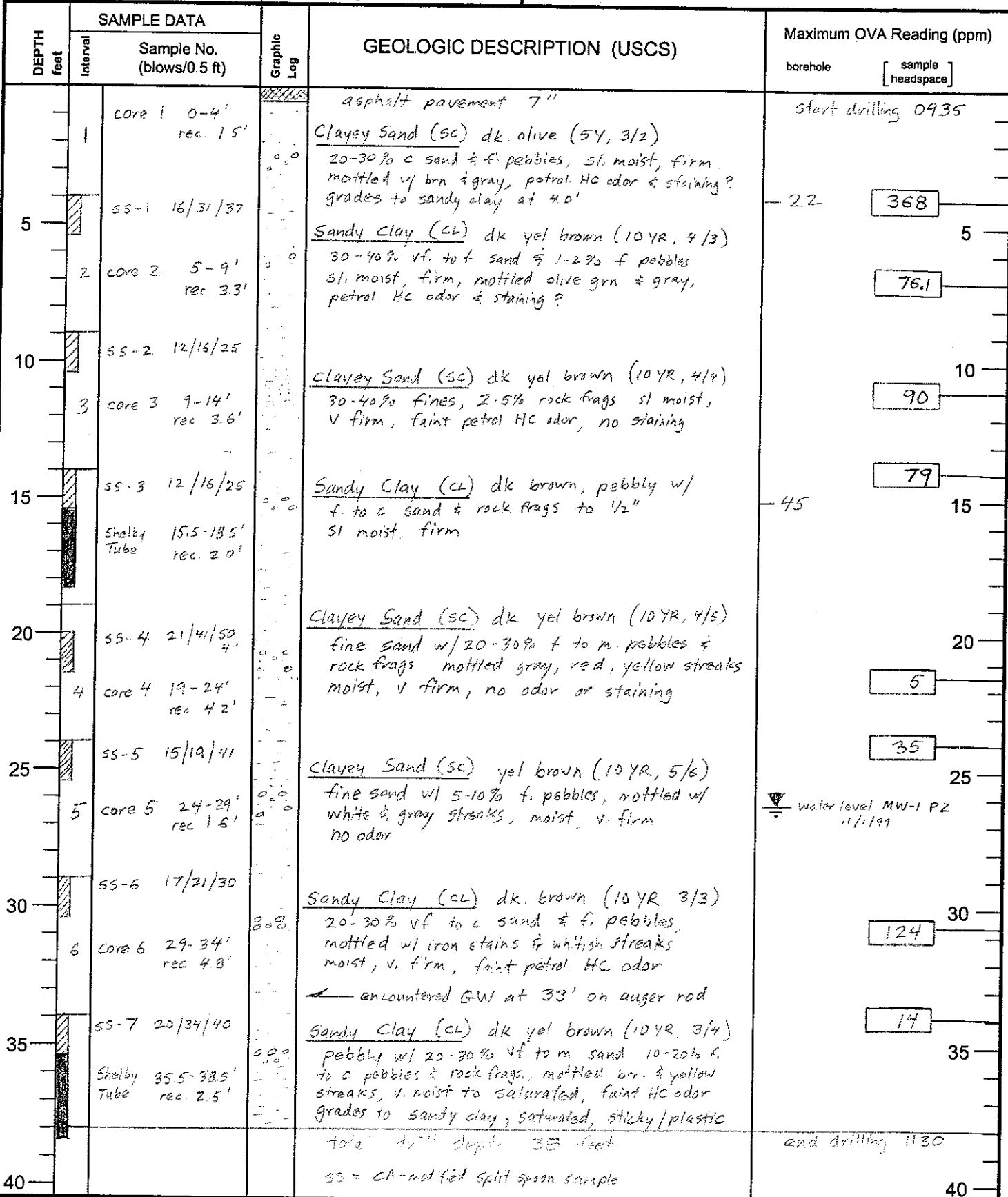


0 5 10
Scale: One inch equals
approximately 10 feet

Contour Interval: Variable
Project Number 9910271M
October 27 1999

SPECTRUM
GEOPHYSICS
622 Glenoaks Boulevard
San Fernando CA 91340

Appendix B
Soil Boring Logs



Project: NMCR Los Angeles Site Inspection				LOG OF BORING NO. MW-02	
Project No: 6210 - 024 - FDI - SRV Phase I				Dates of Drilling <u>NOV. 9, 1999</u>	
Location: <u>Inside Vehicle Maintenance Building</u>				Drilling Method <u>Limited Access HSA 10" auger</u>	
Drilling Contractor: <u>Spectrum Exploration</u>				Total Depth of Boring <u>42 ft.</u>	
Geologist: <u>Bertucci</u>		Reviewed By:			

DEPTH feet	SAMPLE DATA		Graphic Log	GEOLOGIC DESCRIPTION (USCS)	Maximum OVA Reading (ppm)	
	Interval	Sample No. (blows/0.5 ft)			borehole	sample [headspace]
		SS = CA-modified split spoon sample	[Hatched Box]	concrete slab 12" thick		Start drilling 0850
5		SS-1 16/57/60	[Dashed Box]	cuttings: Silty clay (CL) dk brown, w/ 10% f. sand moist, soft, no odor or staining		
			[Dashed Box]	Sandy Clay (CL) v. dk gray brn (10YR 3/2) 20-30% vf - m sand w/ 5% f. pebbles. sl moist, sl firm, mottled w/ dk gray (stained?) no petrol HC odor	2.0	0.9
10		SS-2 30/31/50	[Dashed Box]	Clayey Sand (SC) dk. yell. brown (10YR, 3/4) 60-70% vf - coarse sand, 40-50% fines, sl. moist, very firm, no odor or staining	Ø	1.0
			[Dashed Box]	Sandy Clay (CL) at 10.5' w/ 25% f - med sand moist, firm, no odor or staining		
15		SS-3 9/26/35	[Dashed Box]	Silty Sand (SM) yell. brown (10YR, 5/6) ~80% poorly graded vf - m sand, ~20% fines sl. moist, loose, crumbly, no odor or staining	1.1	Ø
20		SS-4 25/30/45	[Dashed Box]	Sandy Clay (CL) yell. dk. brown (10YR, 4/4) ~25% vf - m. sand, moist, sl. firm possible faint HC odor, no staining	1.8	3.4
25		SS-5 35/42/51	[Dashed Box]	Sandy Clay (CL) olive brown (2.5Y, 4/3) ~15% vf - f. sand, v moist, soft, plastic no odor or staining	2.0	1.1
30			[Dashed Box]			water level
			[Dashed Box]		64	
35		SS-6 26/21/24 Geotechnical sample	[Dashed Box]	← encountered Gwl at 33'		
			[Dashed Box]	Sandy Clay (CL) olive brown (2.5Y, 4/3) ~10% vf - m sand, saturated, soft, plastic, sticky, faint petrol-HC odor	2.0	
40			[Dashed Box]	total drill depth 42' (hard drilling 40-42')		

Project: NMCRC Los Angeles Site Inspection				<h2 style="margin: 0;">LOG OF BORING NO. MW-03</h2>	
Project No: 6210 - 024 - FDI - SRV Phase I					
Location: south side Adm. Bldg. (BACKGROUND)					
Drilling Contractor: Spectrum Exploration					
Geologist: Bertucci		Reviewed By:		Dates of Drilling: Nov. 4, 1999	
				Drilling Method: HSA 10" auger	
				Total Depth of Boring: 42 ft.	

DEPTH feet	SAMPLE DATA		Graphic Log	GEOLOGIC DESCRIPTION (USCS)	Maximum OVA Reading (ppm)	
	Interval	Sample No. (blows/0.5 ft)			borehole	[sample headspace]
		SS = CA-modified split spoon sample	XXXX	asphalt pavement 5"		start drilling 1415
5		SS-1 7/6/9 rec 0.7'	0.0	cuttings: sandy, pebble clay (construction fill) Sandy Clay (CL) dk yell. brown (10YR, 4/4) ~ 25% vf. - coarse sand, ~ 5% f. pebbles moist, sl. firm (possible construction fill) no odor or staining	0.0	5
10		SS-2 7/8/9	0.0	Sandy Clay (CL) dk. yell. brown (10YR, 3/4) ~ 25% vf. to m. sand, < 5% shell frags moist, sl. firm, no odor or staining	0.0	10
15		SS-3 9/10/10	0.0	Sandy Clay (CL) dk. brown (10YR, 3/3) ~ 35% vf. - m. sand, ~ 25% shell frags (large mollusc shell frags), moist, sl. firm no odor	0.0	15
20		SS-4 12/12/12	0.0	Silty Clay (CL) brown (as above) ~ 10% vf. - f. sand, moist, homogeneous soil w/ abundant whitish thin streaks & veinlets	0.0	20
25		SS-5 8/9/10	0.0	Pebbly Clay (CL) dk. brown (10YR, 3/2) ~ 10% med. pebbles & rock frags (chert) ~ 10% f-m sand, v. moist, soft/crumbly	0.0	25
30			0.0	cuttings Silty Clay (CL) lt. brown v. moist, soft, slightly plastic	0.0	30
35			0.0	encountered GW at 34' on drilling rod	0.0	35
40			0.0	cuttings Silty Clay (CL) as above	0.0	40
				total drill depth 42 feet		

water level
in borehole 11/4

Project: NMCRC Los Angeles Site Inspection		LOG OF BORING NO. MW-04
Project No: 6210 - 024 - FDI - SRV Phase I		
Location: parking area, northside Admin. Bldg.		
Drilling Contractor: Spectrum Exploration		
Geologist: Bertucci	Reviewed By:	Dates of Drilling: Nov. 8, 1999
		Drilling Method: HSA 10" auger
		Total Depth of Boring: 19 ft.

DEPTH feet	SAMPLE DATA		Graphic Log	GEOLOGIC DESCRIPTION (USCS)	Maximum OVA Reading (ppm)	
	Interval	Sample No. (blows/0.5 ft)			borehole	sample headspace
		SS = CA - modified split-spoon sample		asphalt pavement 4"		start drilling 10'45"
5		SS-1 6/45/NA		Clayey Sand (SC) yellow brown (10YR, 6/6) ~ 70% v.f.-m. sand w/ ~ 30% fines sl. moist, v. firm, homogeneous soil no odor or staining	Ø	1.2 5
10		SS-2 12/25/40		Clayey Sand (SC) <same as above>	Ø	Ø 10
15		SS-3 16/51/NA		Clayey Sand (SC) brn yellow (10YR, 6/8) ~ 60% v.f.-f. sand w/ ~ 40% fines sl. moist, v. firm, homogeneous	Ø	Ø 15
20		SS-4 36/50/NA		Clayey Sand (SC) <same as above>		
20				terminate drilling at 19 feet (approaching auger refusal)	Ø	20
25				no groundwater encountered decide to seal borehole & drill & install background well adjacent to boring DP-04		25
30						30
35						35
40						40

Project: NMCRC Los Angeles Site Inspection				LOG OF BORING NO. <u>MW-05</u>	
Project No: 6210 - 024 - FDI - SRV <i>Phase I</i>				Dates of Drilling <u>Nov. 5, 1999</u>	
Location: <u>downgradient</u>				Drilling Method <u>HSA 10" auger</u>	
Drilling Contractor: <u>Spectrum Exploration</u>				Total Depth of Boring <u>36 ft.</u>	
Geologist: <u>Berlucci</u>			Reviewed By: _____		

DEPTH feet	SAMPLE DATA		Graphic Log	GEOLOGIC DESCRIPTION (USCS)	Maximum OVA Reading (ppm)	
	Interval	Sample No. (blows/0 5 ft)			borehole	[sample headspace]
		SS = CA - modified split spoon sample	XXXX	asphalt pavement 5" cuttings: <u>Gravelly Sand</u> with brick frags. (construction, road base)		start drilling 10:10
5		push 1 ft for logging	XXXX	<u>Sandy clay (CL)</u> dk. brown (10YR, 3/3) ~ 35% vf to f. sand, < 5% fine pebbles, ½ shell frags, moist, sl. firm, homogeneous no odor	Ø	5
10		SS-1 10/21/40	XXXX	<u>Silty Sand (SM)</u> lt olive brown (2.5Y, 5/3) ~ 75% poorly graded vf to f. sand, ~ 25% silt/clay moist, loose/crumbly, homogeneous, no odor	Ø	10
15		SS-2 12/16/18	XXXX	<u>Sandy Clay (CL)</u> olive brn (2.5Y, 4/3) ~ 25% vf -m. sand, moist, partly soft sticky/plastic (same as above)	Ø	15
20		SS-3 pushed for Geotechnical sample	XXXX	<u>Sandy Clay (CL)</u> olive brn (2.5Y, 4/3) ~ 25% vf -f. sand, w/ whitish gray streaks ½ veinlets, moist, sticky/plastic	Ø	20
25		SS-4 11/20/22	XXXX	<u>Sandy Clay (CL)</u> olive brn (2.5Y, 4/3) ~ 25% vf -f. sand, w/ whitish gray streaks ½ veinlets, moist, sticky/plastic	Ø	25
30		SS-5 20/28/30	XXXX	<u>Sandy Clay (CL)</u> yell brn (10YR, 5/6) ~ 35% vf -m. sand, moist, firm ← encountered GW at 26'	Ø	30
35		SS-6 push for Geotechnical sample	XXXX	cuttings to total depth: <u>sandy clay</u> saturated, sticky/plastic	Ø	35
40			XXXX	total depth drilled 36 feet		40

Project: NMCRC Los Angeles Site Inspection			<h2 style="margin: 0;">LOG OF BORING NO. MW-06</h2>	
Project No: 6210 - 024 - FDI - SRV Phase II				
Location: <i>downgradient, property line</i>			Dates of Drilling <u>Jan. 25, 2000</u>	
Drilling Contractor: <i>Spectrum Exploration</i>			Drilling Method <u>HSA 10" auger</u>	
Geologist: <i>Bertucci</i>		Reviewed By:	Total Depth of Boring <u>38 ft.</u>	

DEPTH feet	SAMPLE DATA		Graphic Log	GEOLOGIC DESCRIPTION (USCS)	Maximum OVA Reading (ppm)	
	Interval	Sample No. (blows/0.5 ft)			borehole	[sample headspace]
				asphalt pavement 4" road base compacted gravel fill to 1'	start drilling	1100
5		SS-1 6/8/11 rec. 0.8'		Sandy Clay (CL) v. dk. grayish brown (10YR, 3/2) ~ 30% vf. to med. sand, homogeneous. sl. moist, partly firm, no odor or staining	Ø	5
10		SS-2 9/17/22 rec. 1.2'		clayey Sand (SC) dk. grayish brown (2.5Y, 3/2) ~ 60% vf. to med. sand, ~ 30% silt-clay and 10% fine pebbles to 1/4", sl. moist, sl. firm no odor or staining	Ø	10
		Shelby 11-13.5' Tube rec. 2.5'		Sandy Clay (CL) as above		
15		SS-3 14/14/19 rec. 1.1'		sand (SW) lt. gray brown, well-graded vf. to med. sand w/ ~ 10% silt-clay sl. moist, friable no odor or staining	Ø	15
		SS-4 5/11/12 rec. 1.2'		Sand (SW) lt. yellowish brown (2.5Y, 6/4) vf. to med. sand w/ ~ 20% silt-clay sl. moist, med. density, homogeneous, no odor	Ø	15
20				Sandy Clay (CL) olive (5Y, 5/3) ~ 20% vf. to med. sand, micaceous, w/ < 5% fine pebbles to 1/4", mottled w/ gray streaks moist, firm, no odor	3.6	20
25				no water entry at 25'	15.6	25
30		Shelby 27-29.5' Tube rec. 1.9'		Pebbly Clay (CL) dk. olive gray (2.5Y, 3/2) ~ 20% fine pebbles to 1/2" angular chips w/ ~ 10% vf. to c. sand, moist, sticky plastic, no odor	7.3	30
35				first GW entry, water on drill rod at 35' Very slow GW recharge prior to and during well installation (mw-06)		35
40				total drilled depth 38 feet SS = CA-modified split spoon sample		40

Project: NMCRC Los Angeles Site Inspection			LOG OF BORING NO. MW-07	
Project No: 6210 - 024 - FDI - SRV Phase II				
Location: downgradient of Lube Rack area			Dates of Drilling Jan. 24, 2000	
Drilling Contractor: Spectrum Exploration			Drilling Method HSA 10" auger	
Geologist: Bertucci		Reviewed By:	Total Depth of Boring 37 ft.	

DEPTH feet	SAMPLE DATA		Graphic Log	GEOLOGIC DESCRIPTION (USCS)	Maximum OVA Reading (ppm)	
	Interval	Sample No. (blows/0.5 ft)			borehole	sample headspace
			XXXX	asphalt pavement 6" cuttings: sandy clay, dk brown, moist sl. firm		start drilling 1010
5		SS-1 5/11/25 rec. 1.0'		Sandy Clay (CL) dk brown (7.5YR, 3/2) 30-40% vf. to coarse sand, micaceous, homogeneous, sl. moist, sl. firm, no odor or staining	Ø	5
10		SS-2 4/9/11 rec. 0.9'		Clayey Sand (SC) dk olive brown (2.5Y, 3/3) ~ 60% vf. to med. sand, 30% clay-silt < 10% fine pebbles to 1/4", micaceous, faint mottling gray and white, sl. moist, sl. firm, no odor	Ø	10
15		Shelby 13-15.5' Tube rec. 2.3'		Sandy Clay (CL) dk olive brown (2.5Y, 3/3) ~ 30% vf. to med. sand, sl. moist, sl. firm		15
20		SS-3 4/12/15 rec. 1.1'		Sandy Clay (CL) olive brown (2.5Y, 4/4) 30% vf. to med. sand, sl. moist, no odor mottled w/ yellow-rust and gray streaks	Ø	20
25		SS-4 6/18/20 rec. 1.3'		Sandy Clay (CL) dk. olive gray (2.5Y, 4/1) ~ 40% vf. to coarse sand, mottled w/ yellow rusty and gray streaks, sl. moist, sl. firm slight petrol. HC odor, no staining	2.6	25
30		Shelby 30-32.5' Tube rec. 2.0'		encountered GW at 30' on drill rod cuttings: olive gray sandy clay (CL), saturated sticky plastic.		30
35				total drilled depth 37'	27	35
40				installed monitoring well MW-07 SS = CA-modified split spoon sampler		40

Project: NMCRC Los Angeles Site Inspection		<h1 style="margin: 0;">LOG OF BORING NO. DP-01</h1>
Project No: 6210 - 024 - FDI - SRV <i>Phase I</i>		
Location: Lube Rack area		
Drilling Contractor: Spectrum Exploration		
Geologist: P. Bertucci	Reviewed By:	Dates of Drilling <u>Nov. 3, 1999</u> Drilling Method <u>HSA 6" auger</u> Total Depth of Boring <u>38 ft.</u>

DEPTH feet	SAMPLE DATA		Graphic Log	GEOLOGIC DESCRIPTION (USCS)	Maximum OVA Reading (ppm)	
	Interval	Sample No. (blows/0.5 ft)			borehole	[sample headspace]
				asphalt pavement 6"	start drilling 0800	
5		SS-1 21/31/49		Sandy Clay (CL) v dk. gray brown (10YR, 3/2) 10-20% v.f. to m sand, micaceous, silty sl moist, firm, w/ petrol HC odor & staining	17	228-5
10		SS-2 20/30/38		Sandy Clay (CL) dk yel. brown (10YR, 4/4) same as above, sl moist, firm, homogeneous soil structure, petrol HC odor	115	333-10
15		SS-3 21/29/34		Clayey Sand (SC) dk yel brown (10YR, 4/6) ~60-70% v.f. to m sand w/ fines & pebbles sl moist, firm, w/ whitish streaks faint petrol. HC odor		471-15
20		SS-4a 17/30/37		Sandy clay (CL) dk. olive brown (2.5YR, 3/3) 20-30% v.f. to m sand, ~2% decomposed shell frags (whitish blebs), HC odor, no staining	187	736-20
		SS-4b 17/21/28		Sandy clay (CL) dk yel brown (10YR, 3/4) 10-20% v.f. to m. sand (same as above) w/ 2-5% f to c. pebbles & rock frags,		
25		SS-5 10/21/26		Sandy Clay (CL) v. dk brown (10YR, 2/2) 30-40% v.f. to m. sand, mottled w/ whitish streaks & blebs (decomposed shel frags) faint petrol HC odor, no staining	127	546-25
30				— encountered GW at 30'		
35				Cuttings: dk olive brown sandy clay saturated, sticky/plastic faint petrol HC odor		
				Installed 2" temp. piezometer (screen 28-33') for water level & GW grab samples		
					356	
40				total drill depth 38 feet		
				SS = CA-modified split spoon sample		

water level DP-1 PZ
11/3/99

Project: NMCRC Los Angeles Site Inspection		LOG OF BORING NO. DP-02
Project No: 6210 - 024 - FDI - SRV <i>Phase I</i>		
Location: <i>Lake Rock area</i>		
Drilling Contractor: <i>Spectrum Exploration</i>		
Geologist: <i>P. Bertucci</i>	Reviewed By:	Dates of Drilling: <i>Nov. 2, 1999</i> Drilling Method: <i>HSA 6" auger</i> Total Depth of Boring: <i>35 ft.</i>

DEPTH feet	SAMPLE DATA		Graphic Log	GEOLOGIC DESCRIPTION (USCS)	Maximum OVA Reading (ppm)	
	Interval	Sample No. (blows/0 5 ft)			borehole	[sample headspace]
			[Hatched Box]	asphalt pavement 6"		
5		SS-1 25/37/50 <i>for 3"</i>	[Dotted Box]	<u>Sandy Clay (CL)</u> v. dk gray brown (2.5Y 3/2) 10-20% v.f. to coarse sand & rock frags to 1/4" sl moist, v firm, no odor or staining	0.0	0.0
10		SS-2 21/36/42	[Dotted Box]	<u>Gravelly Clay (CL)</u> H olive brown (2.5Y, 4/4) 20-30% decomposed angular rock frags & shell frags and 10-20% f to coarse sand sl moist, v firm, no odor or staining	0.0	0.0
15			[Dotted Box]			
20		SS-3 21/47/50 <i>for 3"</i>	[Dotted Box]	<u>Clayey Sand (SC)</u> olive brown (2.5Y, 4/3) ~30% fines and 10-20% fine pebbles (sed rock frags sand is v.f. to med grained moist, firm, no odor or staining	0.0	
25		SS-4 20/36/48	[Dotted Box]	<u>Silty Clay (CL)</u> olive (5Y, 4/3) w/ ~10% v.f. to med sand, w/ thin white streaks and blebs, moist, firm faint petrol. HC odor		21.8
30			[Dotted Box]	← encountered GW at approx 30' cuttings: dk. olive brown, sandy clay saturated, sticky / plastic Installed 2" temp. piezometer (screen 25-35") for water level & GW grab samples	69	
35			[Dotted Box]	total drill depth 35 feet		
40			[Dotted Box]	SS = CA-modified split spoon sample		

Project: NMCRC Los Angeles Site Inspection		<h2 style="margin: 0;">LOG OF BORING NO. DP-08</h2>
Project No: 6210 - 024 - FDI - SRV Phase II		
Location: 70' southeast of Lube Rack		
Drilling Contractor: Spectrum Exploration		
Geologist: Bertucci	Reviewed By:	Dates of Drilling Jan. 25, 2000 Drilling Method HSA 6" auger Total Depth of Boring 38 feet

DEPTH feet	SAMPLE DATA		Graphic Log	GEOLOGIC DESCRIPTION (USCS)	Maximum OVA Reading (ppm)	
	Interval	Sample No. (blows/0.5 ft)			borehole	sample headspace
			XXXX	asphalt pavement 4"		Start drilling 0850
5		SS-1 4/4/8 rec 1.0'		Sandy clay (CL) dk brown (7.5 YR, 3/3) ~40% v.f. to med sand, moist. sl firm no odor or staining	0.0	0.0 5
10		SS-2 8/16/22 rec 0.8'		Sandy clay (CL) dk yel brown (10YR, 3/4) 30-40% v.f. to v. coarse sand, homogeneous sl. moist, sl. firm, no odor or staining	0.0	0.3 10
15		SS-3 5/12/14 rec 1.1'		Sandy clay (CL) dk yel brown (10YR, 3/4) - same as above - no odor or staining	0.0	0.0 15
20					0.0	0.0 20
25		SS-4 7/13/24 rec 1.0'		Sandy clay (CL) dk gray brown (2.5Y, 4/2) ~30% v.f. to m sand w/ <5% f. pebbles to 1/4" mottled w/ olive gray, rust, gray streaks sl. moist, sl. firm, no odor	0.0	0.0 25
30				cutting at 28': sandy clay w/ faint petrol. HC odor encountered GW at approx 29'	9.6	9.6 30
35				cuttings: olive gray sandy clay, saturated sticky, plastic Installed 2" temp piezometer (screen 28-38') for water level & GW grab sample.		35
40				total drilled depth 38 feet SS = CA-modified split spoon sample		40

Project: NMCRC Los Angeles Site Inspection		LOG OF BORING NO. DP-09
Project No: 6210 - 024 - FDI - SRV Phase II		
Location: 70' south of Luba Rock		
Drilling Contractor: Spectrum Exploration		
Geologist: Bertucci	Reviewed By:	Dates of Drilling: Jan. 24-25, 2000
		Drilling Method: HSA 6" auger
		Total Depth of Boring: 38 feet

DEPTH feet	SAMPLE DATA		Graphic Log	GEOLOGIC DESCRIPTION (USCS)	Maximum OVA Reading (ppm)	
	Interval	Sample No. (blows/0.5 ft)			borehole	[sample headspace]
				asphalt pavement 5"		start drilling 1510 1/24
5		SS-1 7/20/31 rec 1.0'		Sandy Clay (CL) dk brown (104R, 3/3) ~30% v.f. to med. sand, w/ 5-20% f. pebbles to 1/2", sl. moist, v. firm, no odor or staining	Ø	Ø 5
10		SS-2 5/12/16 rec 0.8'		Clayey Sand (SC) dk olive brown (25Y, 3/3) ~60% v.f. to med. sand, micaceous, w/ fines, homogeneous moist, med. firm, no odor	Ø	Ø 10
15						
20		SS-3 4/9/13 rec 1.2'		Sandy Clay (CL) olive brown (2.5Y, 4/3) ~40% v.f. to coarse sand, mottled w/ rust & yellow & gray streaks, moist, med. firm no odor	Ø	0.6 20
25		SS-4 5/13/15 rec 1.2'		Gravelly Sandy Clay (CL) olive gray (5Y, 4/2) ~30% v.f. to coarse sand, ~10% angular pebbles & rock frags to 1 1/2", mottled w/ yellow & rust/orange streaks, gray veinlets moist, sl. firm, faint petroleum HC odor	3.5	42 25
30				← encountered GW approx 28' cuttings Sandy clay, lt brown, wet sticky/plastic, slight petrol. HC odor		30
35				cuttings as above Installed 2" temp. piezometer (screen 28-38') for water level & GW grab sample		35
				total drilled depth 38 feet	2.1	
40				SS = CA-modified split spoon sample		40

PROJECT: Site Investigation NMRC Los Angeles

PROJECT NO: 6210-024-FD1-SRV

LOCATION: Main terrace, near ^{former} waste oil UST

SURFACE ELEVATION:

DRILLING CONTRACTOR: Spectrum Exploration

GEOLOGIST:

REVIEWED BY:

LOG OF BORING NO. DP-3

Page 1 of 1

Dates of Drilling Nov. 1-2, 1989

Drilling Method DPT (Nov. 1) HSA (Nov. 2)

Total Depth of Boring

DEPTH feet	SAMPLE DATA		Graphic Log	GEOLOGIC DESCRIPTION (USCS)	FIELD MEASUREMENTS AND REMARKS		
	Interval	Sample No. (blows/0.5 ft)			max OVA in hole		OVA of Sample
				asphalt pavement 0.4'	1.5		
5		DP-1 easy push		DK yell brn (10 YR, 4/4) <u>clayey sand (SC)</u> 60-70% v.f. to f. sand w/ fines (s. 4% clay) sl. moist, sl. firm, no odor or stain			5
10		DP-2		Yell brn (10 YR, 5/4) <u>clayey sand (SC)</u> same as above			10
15	16' - push rod stuck			Nov. 2 start 800 AM w/ 6" OD HSA	1.2		15
20		SS-3a 17/27/54 18-19.5 SS-3b 31/57 19.5-20.5		DK yell brn (10 YR, 4/4) <u>clayey sand (SC)</u> 60-70% v.f.-f. sand, 1-2% silt frags & pebbles homogeneous soil structure, sl. moist, sl. firm/crumbly no odor or stain DK yell brown (10 YR, 4/4) <u>pebbly sandy clay (CL)</u> w/ 20-30% v.f.-f. sand & 5-10% fine-med pebbles (decomposed rock frags) moist firm, no odor		14	20
25		SS-4 25-26.5 25/41/50		DK yellow brn (10 YR, 4/8) <u>sandy clay (CL)</u> w/ 10-20% v.f.-f. sand, w/ abundant white & gray streaks & veinlets faint HC odor		65	25
30				Driller reports 1st soil entry / estimated soil			30
35				TD boring at 30' at 9 AM			
38				TD piezometer 25-38 w/ 2 04" end cap			

CDM

PROJECT: Site Investigation NMCRC Los Angeles

PROJECT NO: 6210-024-FDI-SRV

LOCATION: Main level parking lot, near transformer, BACKLOG

SURFACE ELEVATION:

DRILLING CONTRACTOR: Spectrum Exploration

GEOLOGIST:

REVIEWED BY:

LOG OF BORING NO. DP-4

Page 1 of 1

Dates of Drilling 11/3/99

Drilling Method HSA 6" auger

Total Depth of Boring 35'

DEPTH feet	SAMPLE DATA		Graphic Log	GEOLOGIC DESCRIPTION (USCS)	FIELD MEASUREMENTS AND REMARKS		
	Interval	Sample No. (blows/0.5 ft)			max OVA in hole	REMARKS (ppm)	Sample max OVA
				start drilling 10:53 reach TD / end drilling 11:50			
				asphalt pavement ~ 7"			
5		SS1 7/8/12		olive brown (2.5Y, 4/3) clayey silt (ML) w/ <10% vf to m sand & <5% coarse sand & fine pebbles, moist, mod. firm, no odor	0.0		3.4
10		SS2 8/10/12		DK yellow brown (10YR, 4/6) silty clay (CL) w/ 10-20% vf sand & <5% shell frags/chips w/ thin whitish streaks, homogeneous soil structure moist, mod. firm, no odor or staining			2.7
15		SS3 12/16/21		DK yellow brown (10YR, 4/4) silty clay (CL) w/ 30-40% vf to m sand w/ occasional shell frags (<20), moist, firm, no odor			1.7
20							
25		SS4 24/12/15		Brown (7.5YR, 4/3) clayey silt (ML) w/ 10-20% vf to f sand, moist, soft to crumbly, homogeneous soil structure, no odor	2.0		1.4
30				first encounter GW at 30' cuttings: med brown silty clay w/ fine sand v. moist, sticky	30.7	in auger (10 minutes after reading TD)	35
35				total depth of boring 35'			

PROJECT: Site Investigation NMCRC LOS ANGELES

PROJECT NO: 6210-024-FD1-SRV

LOCATION:

SURFACE ELEVATION:

DRILLING CONTRACTOR: Spectrum Exploration

GEOLOGIST:

REVIEWED BY:

LOG OF BORING NO. DP-5

Page 1 of 1

Dates of Drilling 11/3/89

Drilling Method HSA 6" auger

Total Depth of Boring 35

DEPTH feet	SAMPLE DATA		Graphic Log	GEOLOGIC DESCRIPTION (USCS)	FIELD MEASUREMENTS AND REMARKS	
	Interval	Sample No. (blows/0.5 ft)			Max OVA in hole	Sample max. OVA
			start drilling at 1:40			
			asphalt pavement 7'			
5	4	SS-1 10/12/17		DK yell brn (10 YR, 3/6) <u>sandy clay (CL)</u> w/ 20-25% v.f. to fn sand, 1-2% f. pebbles & shell frags. moist, sl. firm. no odor or stain	Ø	1.4
10	11	SS-2 28/37/55		DK yell brn (5 & 6) <u>sandy clay (CL)</u> w/ 20-30% v.f. to m sand. moist, sl. firm no odor or stain		0.4
15	17	SS-3 17/14/17		Yell brown (10 YR 5/6) <u>clayey silt (ML)</u> w/ 10-20% v.f. to m sand sl. moist, mod. firm. homogeneous so" structure	Ø	0.8
25	24	SS-4 15/17/19		SAME AS 185' lt. brn <u>silty clay</u> w/ 10-20% v.f. to m sand mod. moist, mod. firm. homogeneous		
30				No water at 30'		
35		2:30 pm		TD = 35, within GW estimate 1st water ~ 33' Depth to first saturated soil		
BTL in auger 30.8 auger pickup 2.4'						

PROJECT: <u>NWERC</u>			<h1>LOG OF BORING NO. <u>DP-6</u></h1>	
PROJECT NO: <u>6-1-24</u>				
LOCATION: <u>Lower terrace lot</u>			Page <u> </u> of <u> </u>	
SURFACE ELEVATION: <u> </u>			Dates of Drilling <u>11/4/99</u>	
DRILLING CONTRACTOR: <u>Spokane Drilling</u>			Drilling Method <u>HSA 6" auger</u>	
GEOLOGIST: <u> </u>			Total Depth of Boring <u>30'</u>	
REVIEWED BY: <u> </u>				

DEPTH feet	SAMPLE DATA		Graphic Log	GEOLOGIC DESCRIPTION (USCS)	WELL CONSTRUCTION AND FIELD MEASUREMENTS
	Interval	Sample No. (blows/0.5 ft)			
0				Start drilling at 7:55 am End drilling at 8:25 am	
5		5/8/75		asphalt pavement 2" clayey sand (SC) 60-70% v.f. to m. sand, w/ fines SI, med H, SI, firm, no odor or st homogeneous	5
10		2/17/26		olive brn (2.5Y 4/14) clayey sand (SC) med H with brown, med H, sand	10
15		13/1/79		DK olive gray sandy (SC) w/ 20-30% v.f. to f. sand mottled w/ gray & brown patches streaky soft, soft, no odor	15
20				(Same as 15-16.5') olive gr. - med Sandy clay (CL)	20
25					25
30				drilling 22.6' (Bm. 11.5') 30' 11.5'	30
35					



PROJECT: Site Investigation NMCRC Los Angeles

PROJECT NO: 6210-024-FD1-SRV

LOCATION: East area main terrace, near OWS

SURFACE ELEVATION:

DRILLING CONTRACTOR: Spectrum Exploration

GEOLOGIST:

REVIEWED BY:

LOG OF BORING NO. DP-7

Page 1 of 1

Dates of Drilling Nov. 2, 1999

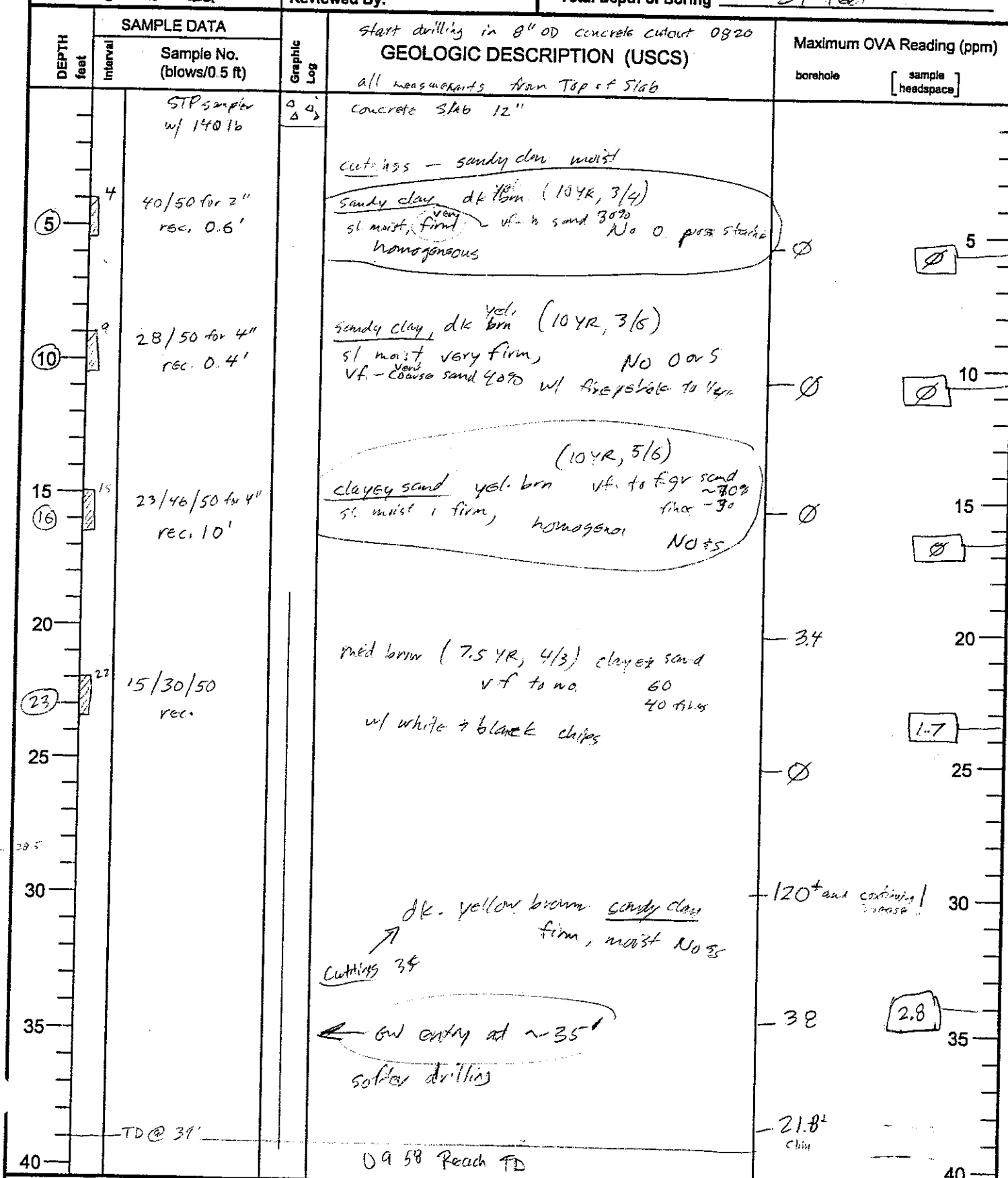
Drilling Method

Total Depth of Boring 33'

DEPTH feet	SAMPLE DATA		Graphic Log	GEOLOGIC DESCRIPTION (USCS)	FIELD MEASUREMENTS AND REMARKS	
	Interval	Sample No. (blows/0.5 ft)			OVA in hole	OVA of Samples
				Start at 10:15 am		
				0.5' asphalt pavement	0.5	
5	4.5	SS-1 25/36/48		Brown (7.5YR 4/4) sandy clay (CL) w/ 20-30% v.f.-f sand 2-5% shell frags, si moist, st. uniform fine sand no odor, homogeneous soil		5
10		SS-2 17/20/25		olive brn. (2.5Y 4/4) firm, moist, sandy clay (CL), w/ 20-30% v.f.-f sand, 5-10% f. pebbles & decomp. shell frags	0.8	10
15	15	SS-3 26/21/22		pebbly sandy clay grading to lt. olive brn. (2.5Y 5/6) silty sand (SM) 70-80% poorly graded f-m sand, w/ minor shales loose/crumbly 20-30% v.f.-m.s. mottled w/ gray streaks & 5% med. pebbles (clast)	at 16'	15
20	21	SS-4 17/20/24		lt olive brown (2.5Y 5/4) sandy clay w/ 20-30% v.f.-in sand, w/ abundant whitish streaks & veinlets & 9-15% brown	2.0	20
30		check for water entry		water entry at approx 32' bgs clayey silt		30
35		33' TD				

Approx. 1 1/2 drum cuttings for 6" boring to 33'

Project: NMCRC Los Angeles Site Inspection		LOG OF BORING NO. DP-10
Project No: 6210 - 024 - FDI - SRV Phase II		
Location: in Vehicle Main. Bldg.		
Drilling Contractor: Spectrum Exploration, Inc.		
Geologist: Bertucci	Reviewed By:	Dates of Drilling: Jan. 26, 2000
		Drilling Method: HSA, LAR w/ 6" Auger
		Total Depth of Boring: 39 feet



Project: NMCRC Los Angeles Site Inspection		LOG OF BORING NO. DP-11
Project No: 6210 - 024 - FDI - SRV Phase II		
Location: in Vehicle Maint. Bldg. at front door		
Drilling Contractor: Spectrum Exploration, Inc.		
Geologist: Bertucci	Reviewed By:	Dates of Drilling: Vehicle Maint Jan, 26, 2000
		Drilling Method: HSA LAR w/ 6" auger
		Total Depth of Boring: 39'

DEPTH feet	SAMPLE DATA		Graphic Log	start drilling in 8" concrete cut-out GEOLOGIC DESCRIPTION (USCS)	Maximum OVA Reading (ppm)	
	Interval	Sample No. (blows/0.5 ft)			borehole	[sample headspace]
		STP w/ 14016 hammer		concrete slab 12"		
				cuttings: dk brown sandy clay		
5	4	16/40/50 for 4" rec. 0.8'		sandy clay dk brn. (10YR, 4/3) v.f. to med 30% sand v. firm, v. sl. moist, mottled w/ dark areas → staining No odor possible	1.8	5.2
10	9	40/50 for 3" rec. 0.7		dk. yel brown (10YR, 5/4) sandy clay, med brn. pebbly ~ 10% to 3/4" v. firm, v. sl. moist v. calcareous No odor no staining	2.1	12.3
15	15	23/40/50 rec. 1.0'		strong brn. (7.5YR, 5/6) sandy clay med brn. v.f. to m. sand 30% v. firm, sl. moist homogeneous no odor or staining	19.7	250.0
20						
23	22	15/40/45 rec. 1.0'		dk yel. brn. (10YR, 4/4) sandy clay, med brn. v. firm, sl. moist, v.f. to med sand 40% trace pebbles to 1/2" No odor or staining	69+	150+
25					180+	
30				yel brown (10YR, 5/6) cuttings - med brn. sandy clay v. moist, sl. soft		180+
35				water cutting ~ 33'	200+	
40				cuttings - lt. brown sandy clay slightly sticky, plastic		
		39' TD		TD = 39' @ 13:50		

unch
break
scale 13:20

9.5 est.

Appendix C

Geotechnical Laboratory Reports

210-024
Geotech Data

**Environmental
Geotechnology
Laboratory**

November 23, 1999

CDM Federal Program
3760 Convoy Street, Suite 210
San Diego, California 92111

Attn: Mr. Dave Bjostad

RE: LABORATORY TEST RESULTS/REPORT

Project Name: CDM US Navy, Los Angeles

Project No.: 6210-024

EGL Job No.: 99-024-004

Dear Mr. Bjostad:


We have completed the testing program conducted on samples from the above project. The tests were performed in accordance with testing procedures as follows:

TEST	METHOD
Moisture Content & Density	ASTM D2937
Specific Gravity	ASTM D854
Grain Size Analysis	ASTM D422
Triaxial Permeability	ASTM D5084
Total Porosity	

Enclosed are Summary of Laboratory Test Results, Summary of Triaxial Permeability Test Results, and Grain Size Distribution Curves.

We appreciate the opportunity to provide testing services to CDM Federal Program. Should you have any questions, please call the undersigned.

Sincerely yours,
Environmental Geotechnology Laboratory, Inc.


Jack C. Lee, PE, GE
Manager



Environmental Geotechnology Laboratory

SUMMARY OF LABORATORY TEST RESULTS

PROJECT NAME: CDM US NAVY, LOS ANGELES

EGL JOB NO : 99-024-004

PROJECT NO.: 6210-024

CLIENT: CDM FEDERAL

DATE: 11-23-99

SUMMARIZED BY: I. HUYNH

BORING NO	DEPTH (FT)	MOISTURE CONTENT ASIM D2216 (%)	DRY DENSITY ASIM D2937 (PCF)	GRAIN SIZE DIS. ASIM D422 **(GR:SA:FI)	SPECIFIC GRAVITY ASIM D854	TOTAL POROSITY
99RC-MW01-S-1-15	N/A			2:35:63	2.672	0.38
99RC-MW01-S-1-35	N/A			3:42:55	2.681	0.38
99RC-MW02-S-1-10	N/A	12.8	117.0	0:46:54	2.697	0.31
99RC-MW02-S-1-36	N/A	24.9	100.5	1:35:64	2.682	0.40
99RC-MW05-S-1-17	N/A	17.9	110.9	0:40:60	2.688	0.34
99RC-MW05-S-1-32	N/A	22.1	103.5	2:34:64	2.721	0.39

**GR:SA:FI = GRAVEL:SAND:FINES

Environmental Geotechnology Laboratory

SUMMARY OF TRIAXIAL PERMEABILITY TEST RESULTS (ASTM D5084)

PROJECT NAME: CDM US Navy, Los Angeles

EGL JOB NO : 99-024-004

PROJECT NO : 6210-024

CLIENT: CDM FEDERAL

DATE: 11-10-99

SUMMARIZED BY: I. HUYNH

SAMPLE ID	DEPTH (FT)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	EFFECTIVE CONFINING PRESSURE (PSI)	HYDRAULIC CONDUCTIVITY (CM/SEC)
99RC-MW01-S-1-15	N/A	17.4	102.8	8.9	3.3E-008
99RC-MW01-S-1-35	N/A	22.2	103.1	20.4	4.4E-007

Environmental Geotechnology Laboratory

SUMMARY OF TRIAXIAL PERMEABILITY TEST RESULTS (ASTM D5084)

PROJECT NAME: CDM US NAVY, LOS ANGELES

EGL JOB NO.: 99-024-004

PROJECT NO.: 6210-024

CLIENT: CDM FEDERAL

DATE: 11-23-99

SUMMARIZED BY: I HUYNH

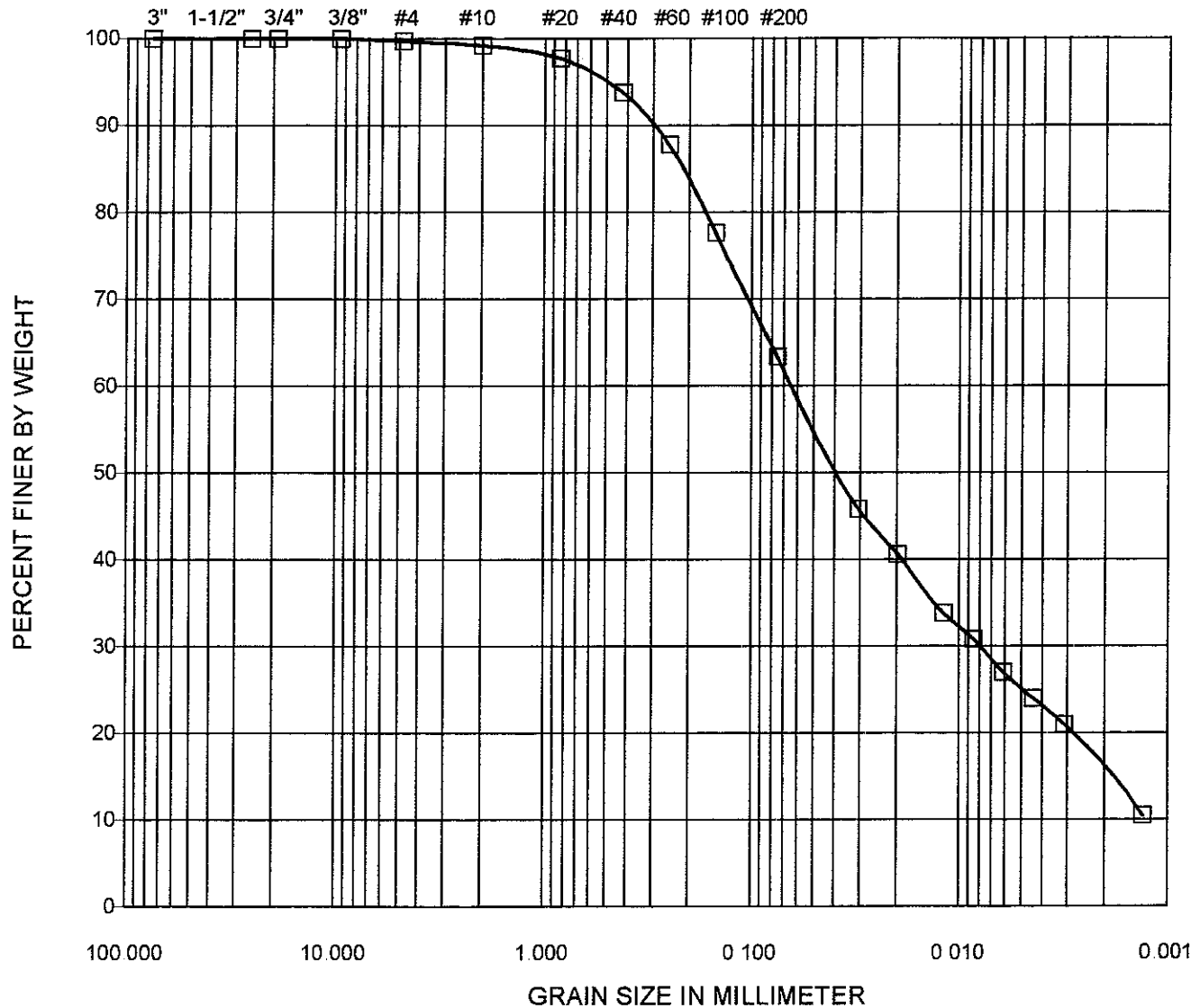
SAMPLE ID	DEPTH (FT)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	EFFECTIVE CONFINING PRESSURE (PSI)	HYDRAULIC CONDUCTIVITY (CM/SEC)
99RC-MW02-S-1-10	N/A	12.8	116.2	6.1	9.4E-009
99RC-MW02-S-1-36	N/A	24.9	100.4	20.9	1.6E-007
99RC-MW05-S-1-17	N/A	17.9	110.6	10.3	1.5E-007
99RC-MW05-S-1-32	N/A	22.1	102.4	18.5	6.0E-009

GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

U.S. STANDARD SIEVE OPENING

U.S. STANDARD SIEVE NUMBER

HYDROMETER



SYMBOL	SAMPLE ID	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
□	99RC-MW01-S-1-15	N/A	N/A	CL	N/A	N/A



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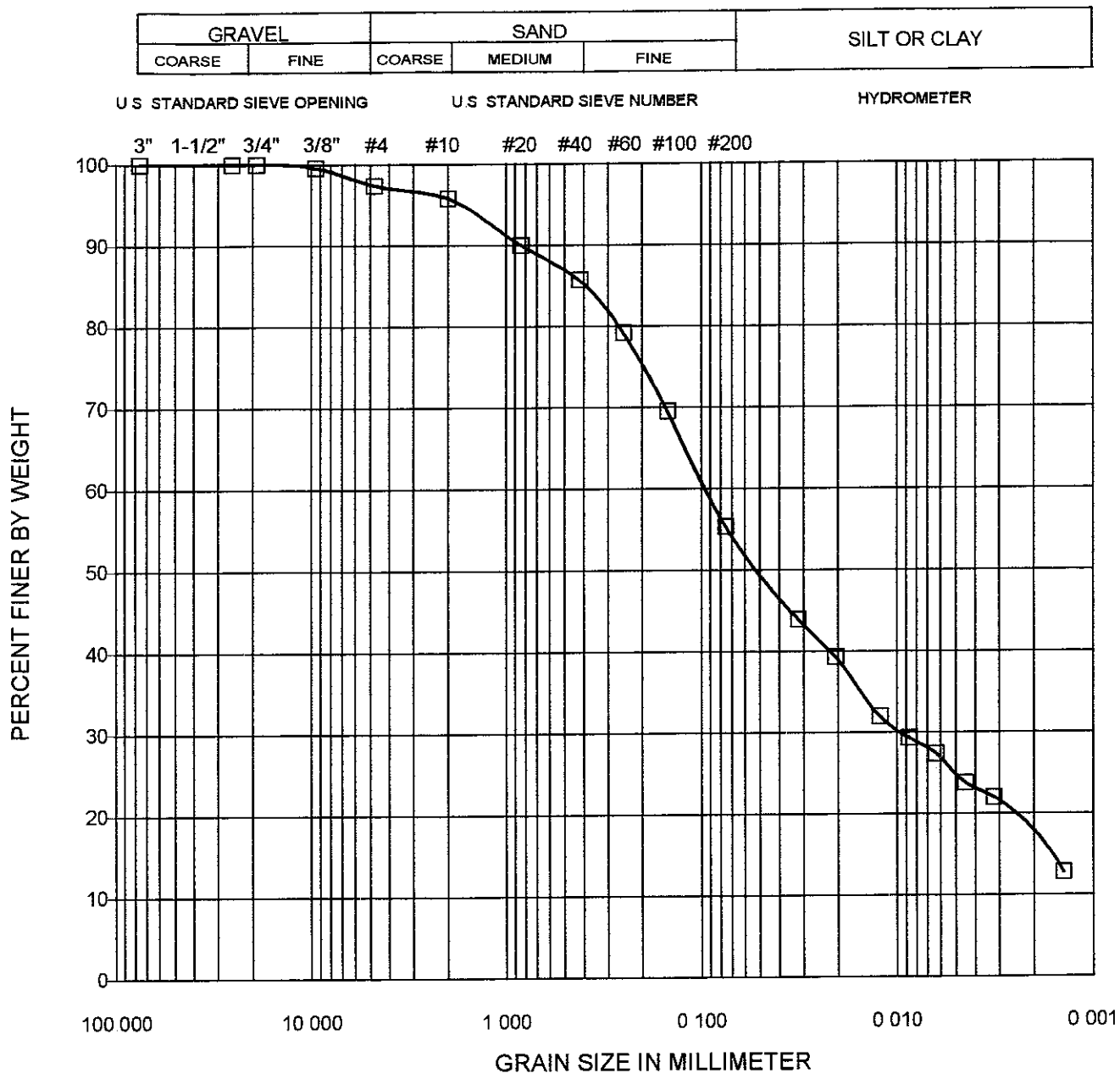
PROJECT NAME:
CDM US Navy
Los Angeles

GRAIN SIZE DISTRIBUTION CURVE

(ASTM D422)

11/99

FIGURE



SYMBOL	SAMPLE ID	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
□	99RC-MW01-S-1-35	N/A	N/A	CL	N/A	N/A



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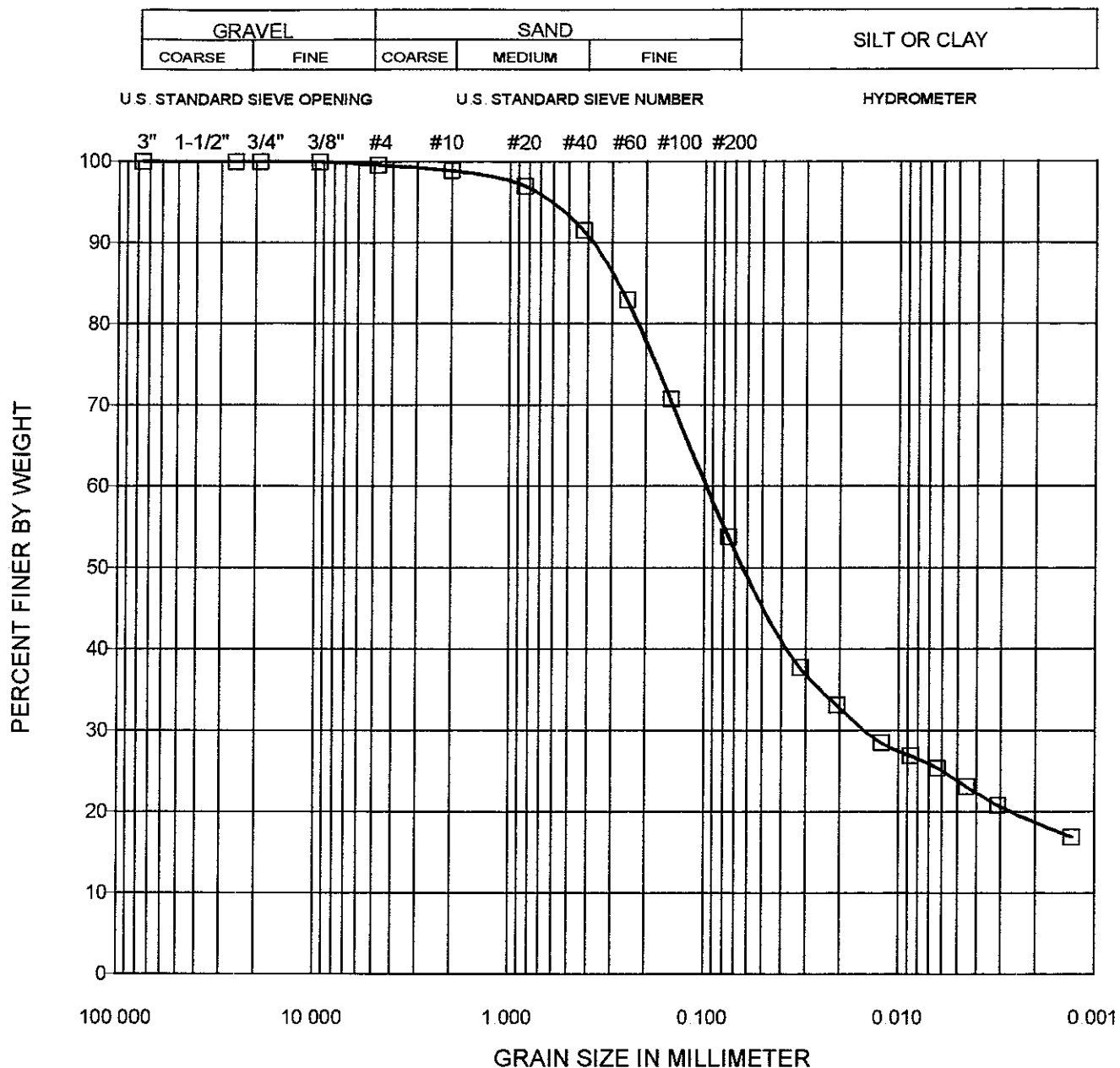
PROJECT NAME:
**CDM US Navy
Los Angeles**

GRAIN SIZE DISTRIBUTION CURVE

(ASTM D422)

11/99

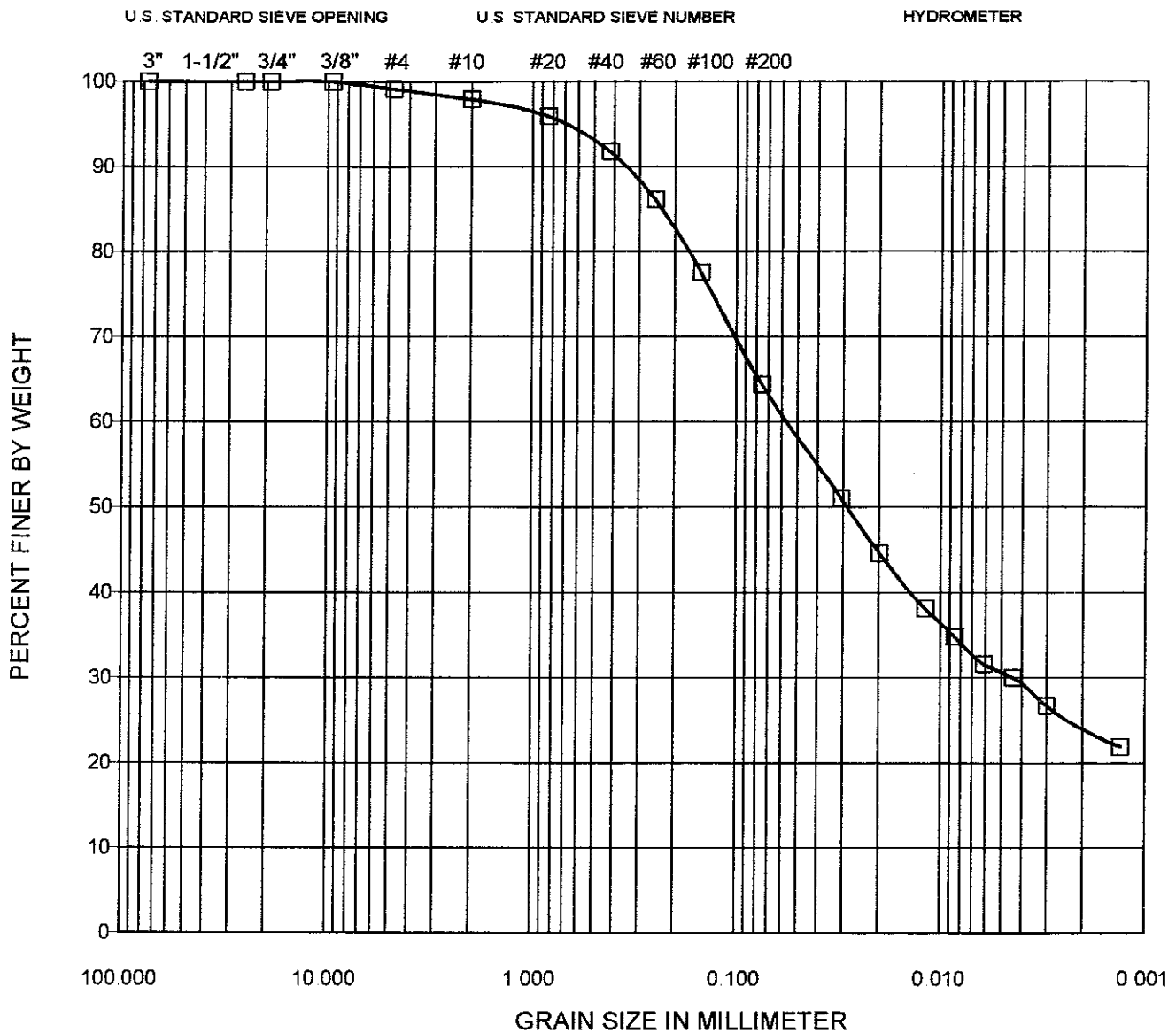
FIGURE



SYMBOL	SAMPLE ID	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
□	99RC-MW02-S-1-10	N/A	N/A	CL	N/A	N/A

	Environmental Geotechnology Laboratory	PROJECT NAME: CDM US Navy Los Angeles
	GRAIN SIZE DISTRIBUTION CURVE (ASTM D422)	
11/99		FIGURE

GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	



SYMBOL	SAMPLE ID	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
□	99RC-MW02-S-1-36	N/A	N/A	CL	N/A	N/A



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PROJECT NAME:
CDM US Navy
Los Angeles

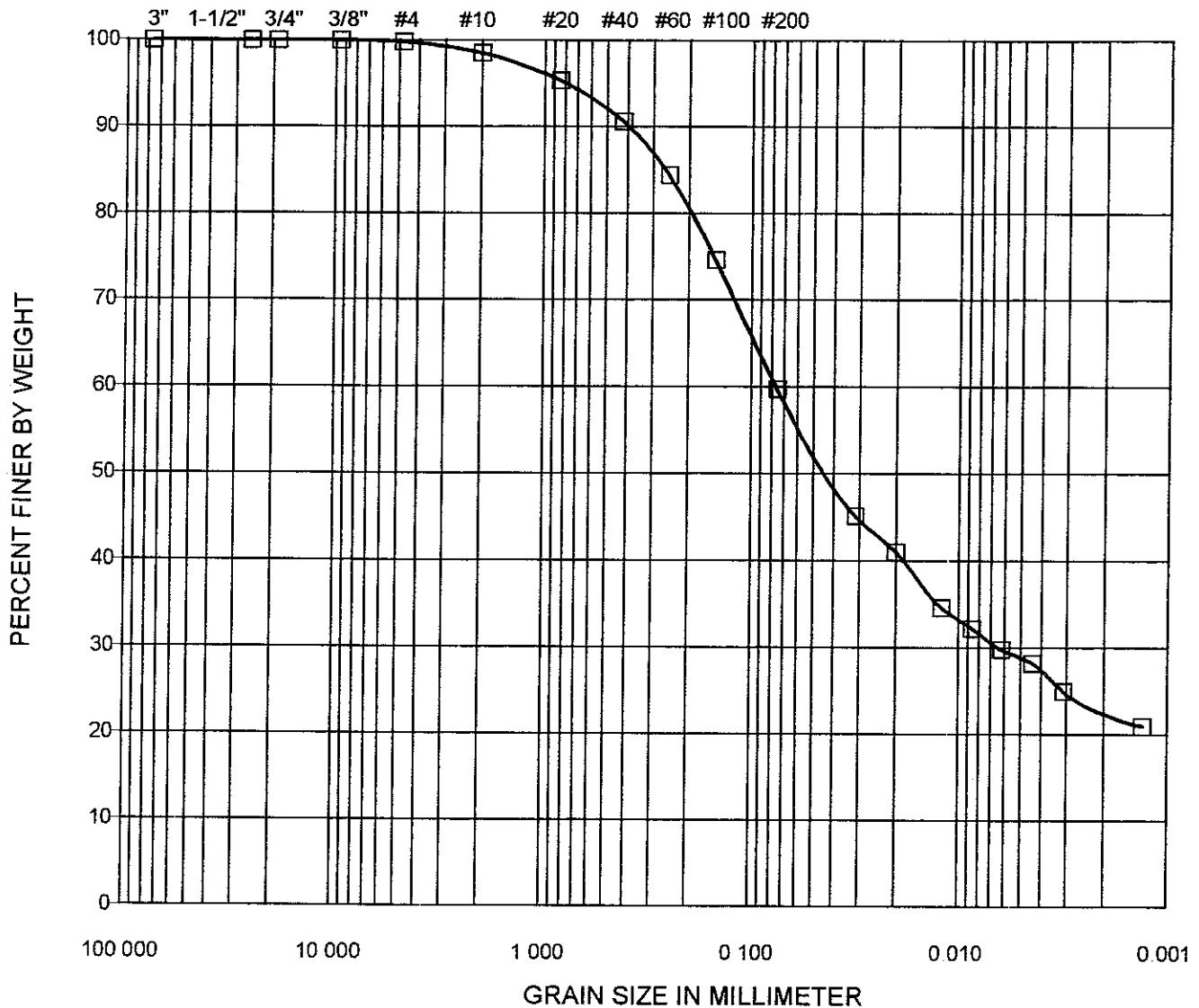
GRAIN SIZE DISTRIBUTION CURVE (ASTM D422)

GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

U.S. STANDARD SIEVE OPENING

U.S. STANDARD SIEVE NUMBER

HYDROMETER



SYMBOL	SAMPLE ID	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
□	99RC-MW05-S-1-17	N/A	N/A	CL	N/A	N/A



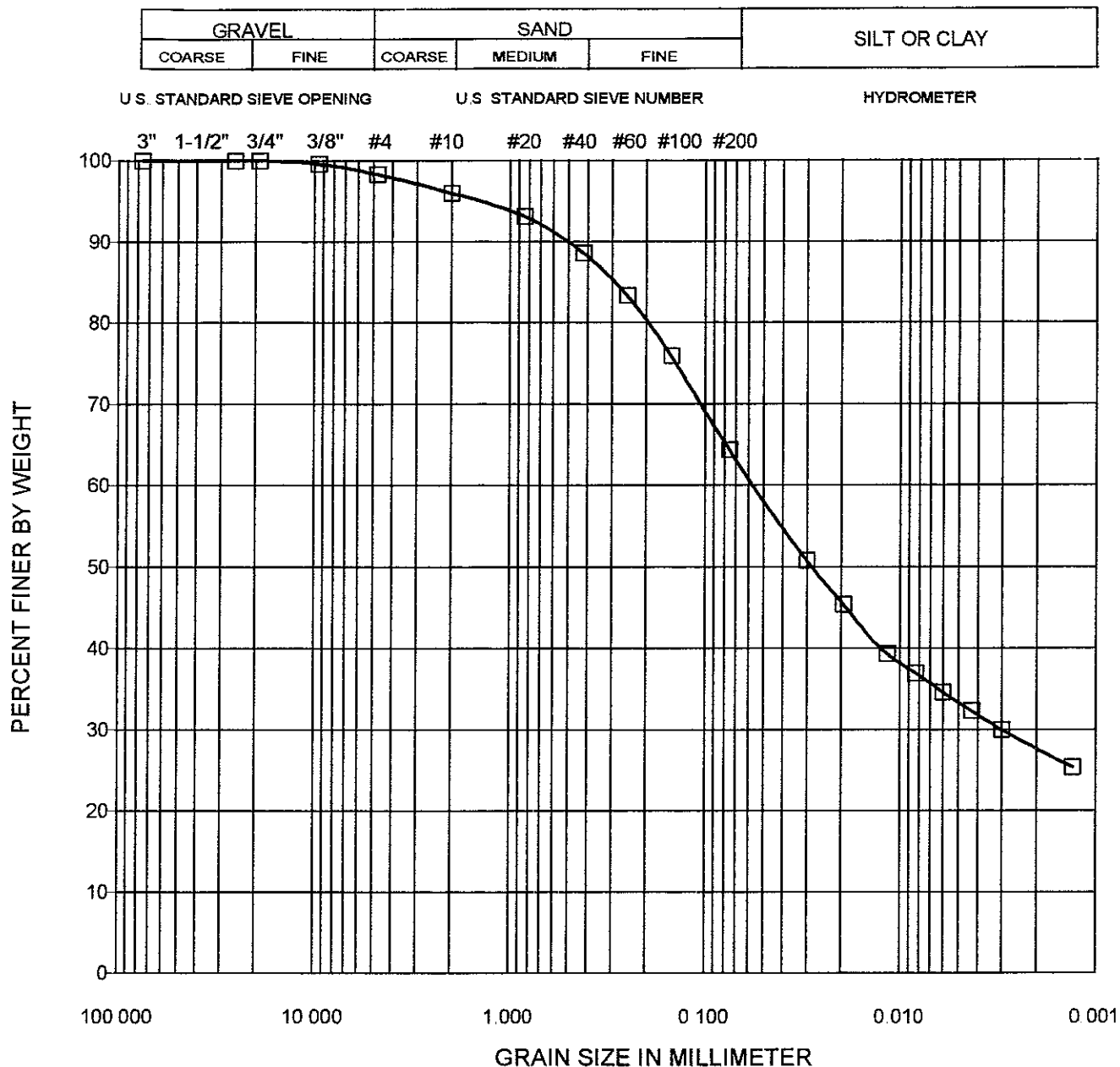
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PROJECT NAME:
CDM US Navy
Los Angeles

GRAIN SIZE DISTRIBUTION CURVE (ASTM D422)

11/99

FIGURE



SYMBOL	SAMPLE ID	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
□	99RC-MW05-S-1-32	N/A	N/A	CL	N/A	N/A



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PROJECT NAME:
CDM US Navy
Los Angeles

GRAIN SIZE DISTRIBUTION CURVE

(ASTM D422)

11/99

FIGURE

**Environmental
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Laboratory**

February 25, 2000

CDM Federal Program
3760 Convoy Street, Suite 210
San Diego, California 92111

Attn: Mr Dave Bjostad

RE: LABORATORY TEST RESULTS/REPORT

Project Name: CDM US Navy, Los Angeles

Project No : 6210-024

EGL Job No.: 99-024-004

Dear Mr Bjostad:

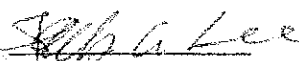
We have completed the testing program conducted on samples from the above project. The tests were performed in accordance with testing procedures as follows:

TEST	METHOD
Moisture & Dry Density	ASTM D2937
Grain Size Analysis	ASTM D422
Triaxial Permeability	ASTM D5084
Total Porosity	

Enclosed are Summary of Laboratory Test Results, Summary of Triaxial Permeability Test Results, and Grain Size Distribution Curves.

We appreciate the opportunity to provide testing services to CDM Federal Program. Should you have any questions, please call the undersigned.

Sincerely yours,
Environmental Geotechnology Laboratory, Inc.


Jack C. Lee, PE, GE
Manager



**ENVIRONMENTAL
GEOTECHNOLOGY
LABORATORY**

SUMMARY OF LABORATORY TEST RESULTS

PROJECT NAME: CDM US NAVY, LOS ANGELES

EGL JOB NO.: 99-024-004

PROJECT NO.: 6210-024

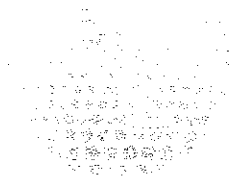
CLIENT: CDM FEDERAL

DATE: 02-24-00

SUMMARIZED BY: T HUYNH

SAMPLE ID	DEPTH (FI)	MOISTURE CONTENT ASIM D2216 (%)	DRY DENSITY ASIM D2937 (PCF)	GRAIN SIZE DIST. ASIM D422 **(GR:SA:FI)	TOTAL POROSITY
00RC-MW06-S-1-13	N/A	8.6	97.4	0:89:11	0.42
00RC-MW06-S-1-29	N/A	21.7	103.4	1:34:65	0.39
00RC-MW07-S-1-15	N/A	18.7	106.3	5:34:61	0.37
00RC-MW07-S-1-30	N/A	22.1	103.3	5:38:57	0.39

**GR:SA:FI = GRAVEL:SAND:FINES



**ENVIRONMENTAL
GEOTECHNOLOGY
LABORATORY**

**SUMMARY OF TRIAXIAL PERMEABILITY TEST RESULTS
(ASTM D5084)**

PROJECT NAME: CDM US NAVY, LOS ANGELES

EGL JOB NO.: 99-024-004

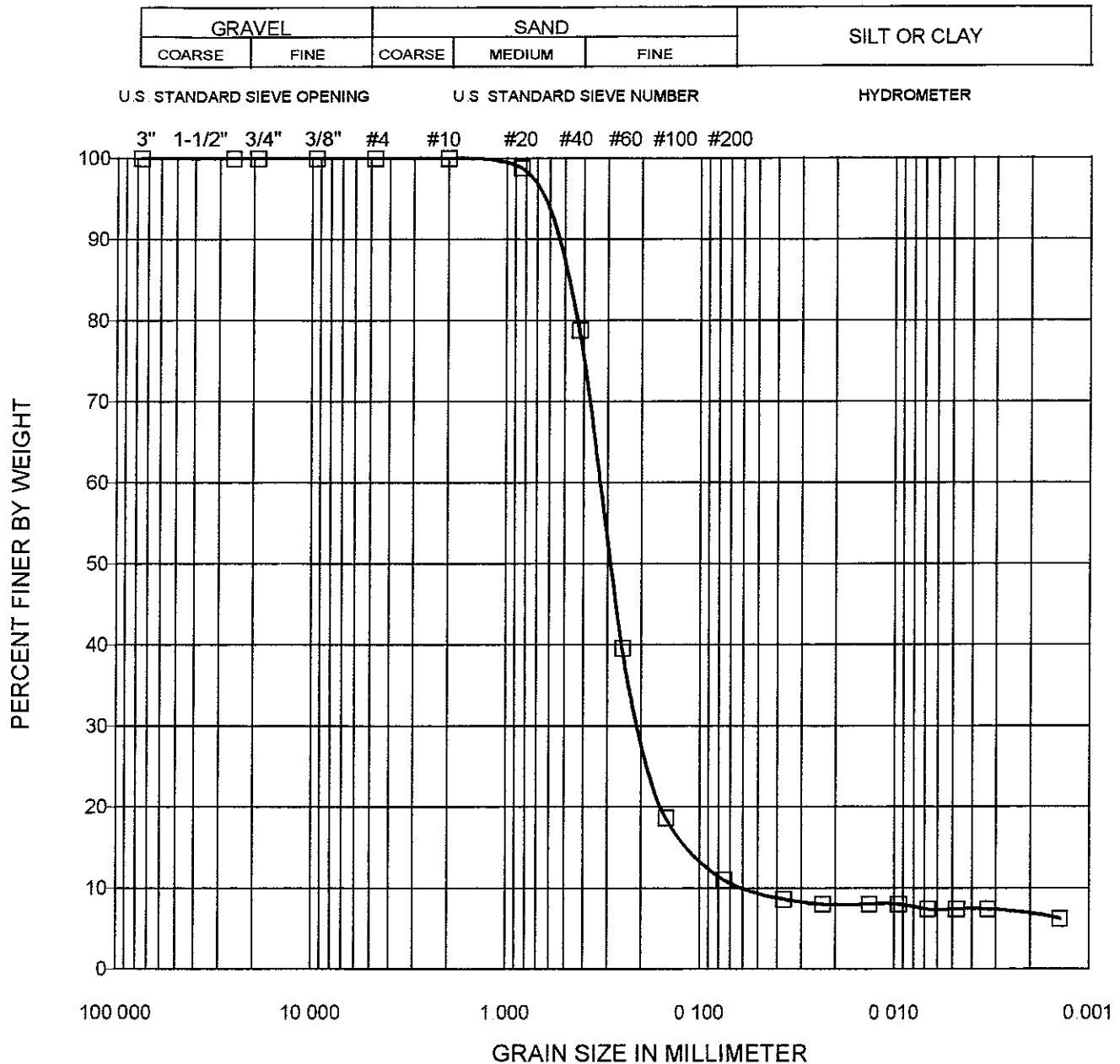
PROJECT NO.: 6210-024

CLIENT: CDM FEDERAL

DATE: 02-24-00

SUMMARIZED BY: I. HUYNH

SAMPLE ID	DEPTH (FT)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	EFFECTIVE CONFINING PRESSURE (PSI)	HYDRAULIC CONDUCTIVITY (CM/SEC)
00RC-MW06-S-1-13	N/A	8.6	97.4	6.4	1.4E-004
00RC-MW06-S-1-29	N/A	21.7	103.4	16.9	1.8E-007
00RC-MW07-S-1-15	N/A	18.7	106.3	8.8	1.2E-006
00RC-MW07-S-1-30	N/A	22.1	103.3	17.5	1.6E-007



SYMBOL	SAMPLE ID	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
□	00RC-MW06-S-1-13	N/A	N/A	SP-SM	N/A	N/A

	Environmental Geotechnology Laboratory	Project Name: CDM US Navy Los Angeles Project No.: 6210-024 EGL Job No.: 99-024-004
	<h2 style="margin: 0;">GRAIN SIZE DISTRIBUTION CURVE</h2> <p style="margin: 0;">(ASTM D422)</p>	

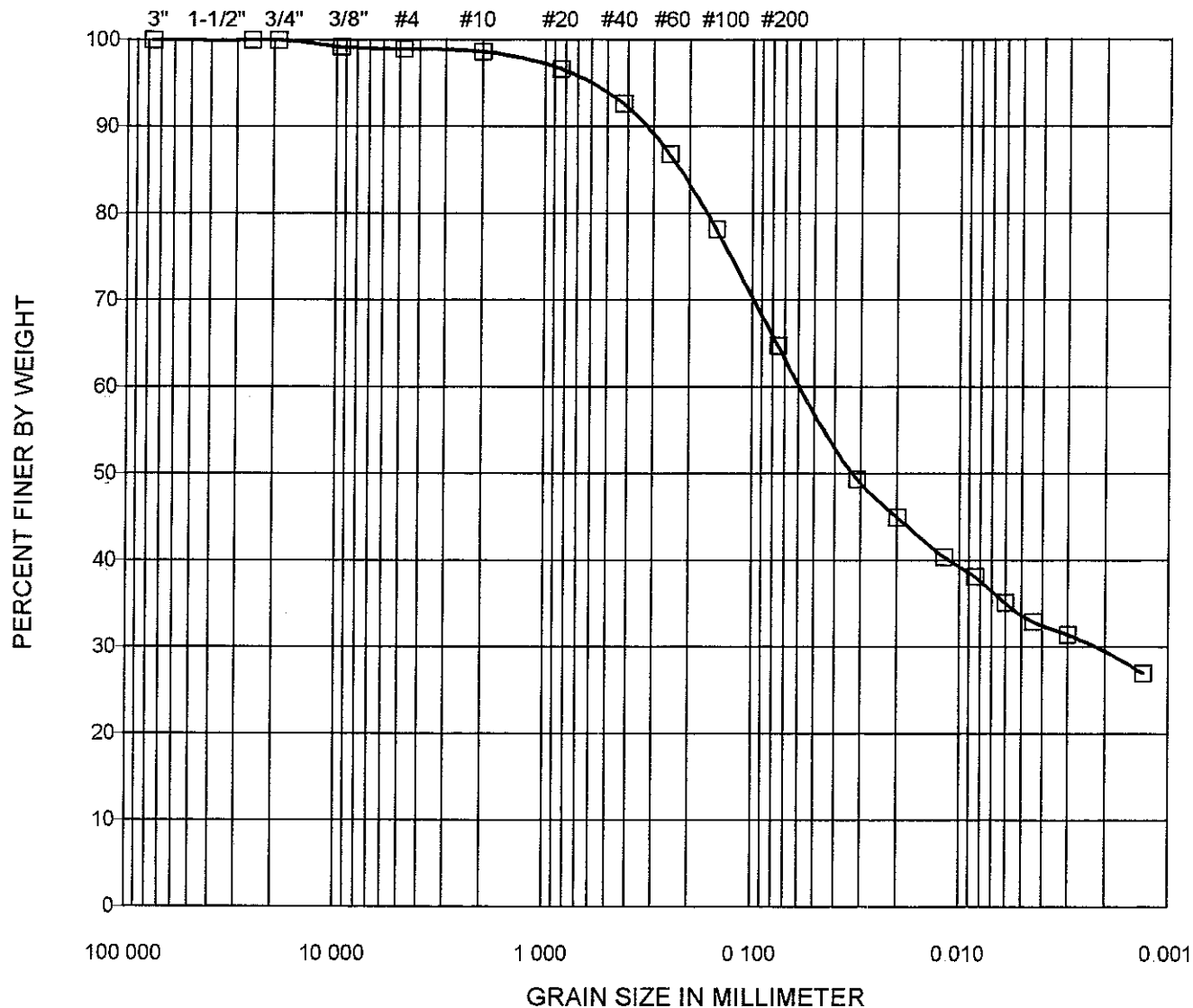
2/00
FIGURE

GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

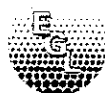
U S STANDARD SIEVE OPENING

U S STANDARD SIEVE NUMBER

HYDROMETER



SYMBOL	SAMPLE ID	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
□	00RC-MW06-S-1-29	N/A	N/A	CL-ML	N/A	N/A



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Project Name:
CDM US Navy Los Angeles
Project No.: 6210-024
EGL Job No.: 99-024-004

GRAIN SIZE DISTRIBUTION CURVE

(ASTM D422)

2/00

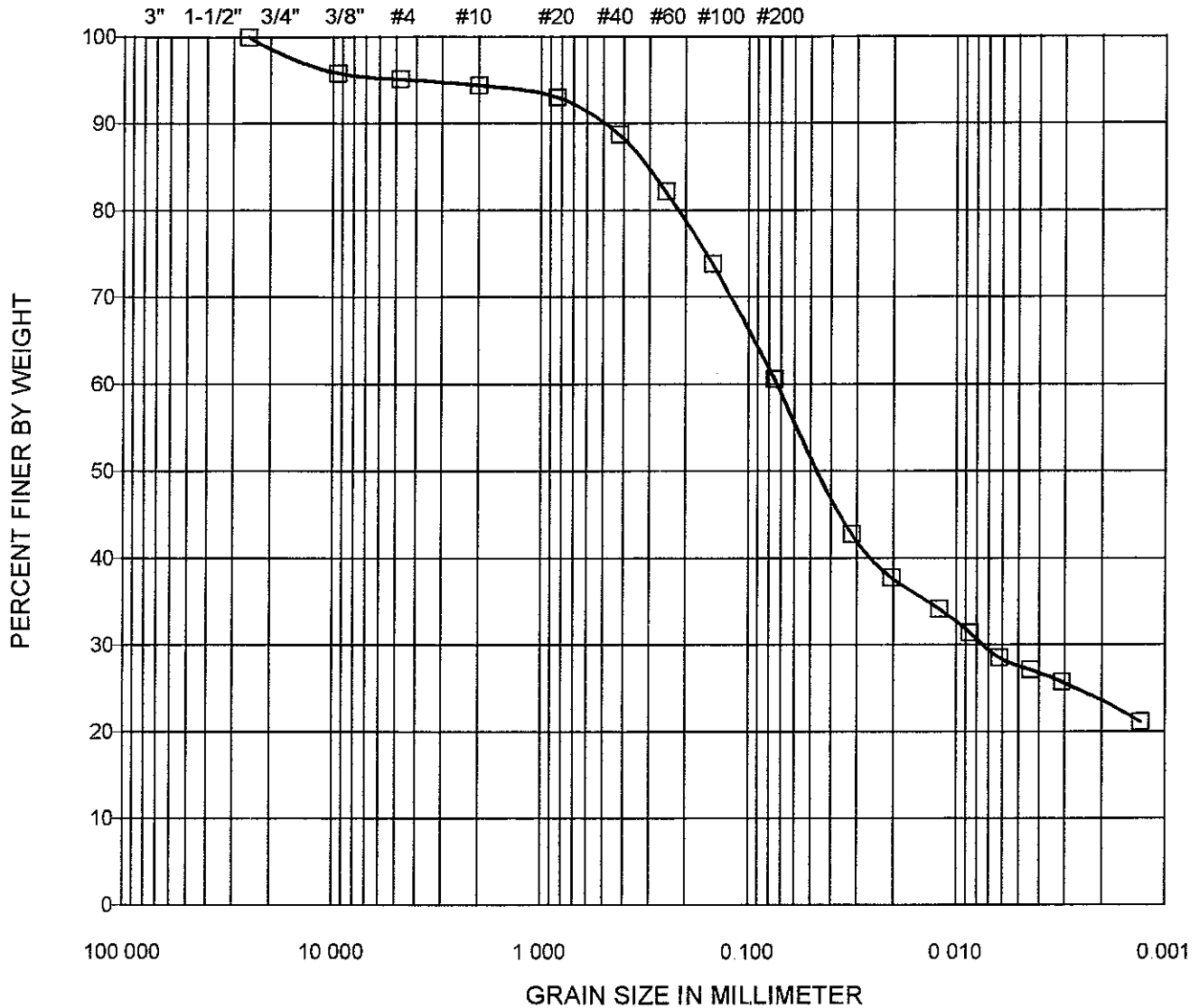
FIGURE

GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

U.S. STANDARD SIEVE OPENING

U.S. STANDARD SIEVE NUMBER

HYDROMETER



SYMBOL	SAMPLE ID	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
□	00RC-MW07-S-1-15	N/A	N/A	CL-ML	N/A	N/A



Environmental
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Laboratory

Project Name:
CDM US Navy Los Angeles
Project No.: 6210-024
EGL Job No.: 99-024-004

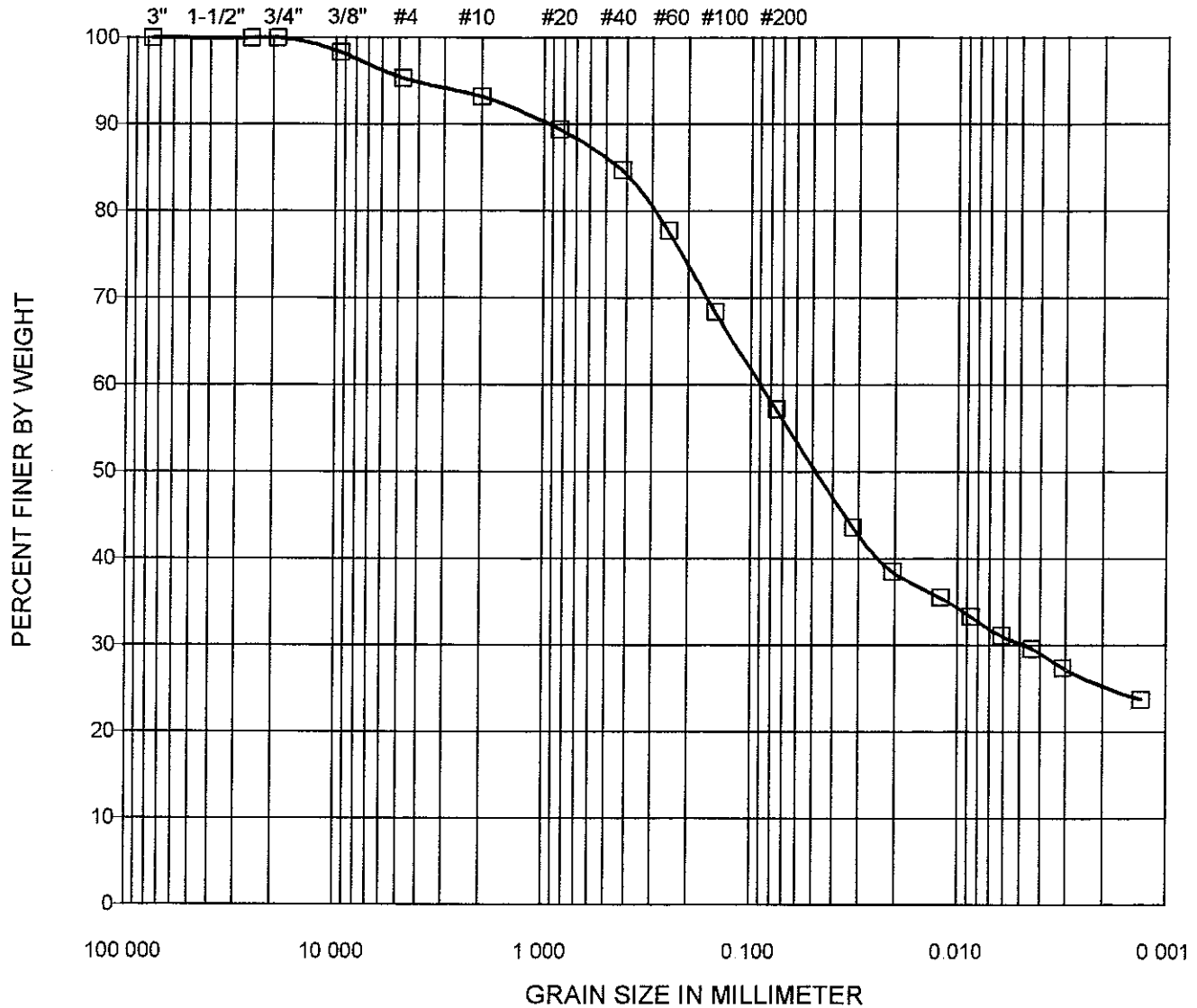
GRAIN SIZE DISTRIBUTION CURVE (ASTM D422)

GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

U.S. STANDARD SIEVE OPENING

U.S. STANDARD SIEVE NUMBER

HYDROMETER



SYMBOL	SAMPLE ID	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
□	00RC-MW07-S-1-30	N/A	N/A	CL-ML	N/A	N/A



Environmental
Geotechnology
Laboratory

Project Name:
CDM US Navy Los Angeles
Project No.: 6210-024
EGL Job No.: 99-024-004

GRAIN SIZE DISTRIBUTION CURVE

(ASTM D422)

Appendix D
Well Construction Logs

Project:	Los Angeles NMCRC Site Inspection
Project No:	6210-024-FDI-SRV
Location:	Lube Rack area
Construction Date:	Nov. 4, 1999
Prepared By:	PFB

WELL CONSTRUCTION SUMMARY

Well Type Monitoring Well Well No MW - 01

WELL CONSTRUCTION DETAIL

Depth
feet below surface

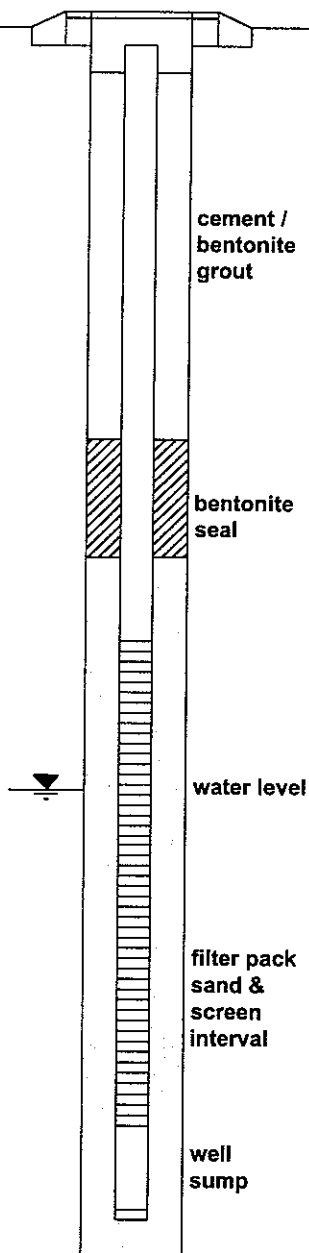
Ground Surface Elevation 397.93
 Measure Point Elevation 397.60
 Measure Point top of casing (TOC)
 Encountered Water During Drilling approx. 33 ft. bgs
 Static Water Level (Date) 26.14 ft. TOC (11/16/99)

DRILLING SUMMARY

Drilling Method hollow stem auger (HSA)
 Borehole Depth, Diameter 0 to 41 ft., 10-inch HSA
 Total Drilled Depth 41 ft.
 Comments Initial boring was drilled on 11/1/99 to 38 ft.
Boring was re-drilled on 11/4/99 for well.

WELL CONSTRUCTION

Total Well Depth 40 ft.
 Plug-back Interval none
 Casing Type, Diameter Sch. 40 PVC, 4-inch
 Screen Type, Diameter Sch. 40 PVC, 4-inch
 Screen Slot Size 0.010-inch, factory slotted
 Sump, Bottom Cap 2-foot blank casing, threaded end cap
 Filter Pack Material # 2/16 Lapis Luster sand
 Well Seal Material bentonite chips
 Grout Material Portland cement & powdered bentonite
 Conductor Casing none
 Centralizers none
 Surface Completion flush-set 12-inch diam. well box
 Comments _____



Not To Scale

Project: Los Angeles NMCRC Site Inspection
 Project No: 6210-024-FDI-SRV
 Location: inside Vehicle Maintenance Building
 Construction Date: Nov. 9, 1999
 Prepared By: PFB

WELL CONSTRUCTION SUMMARY

Well Type Monitoring Well Well No. MW - 02

WELL CONSTRUCTION DETAIL

Depth
feet below surface

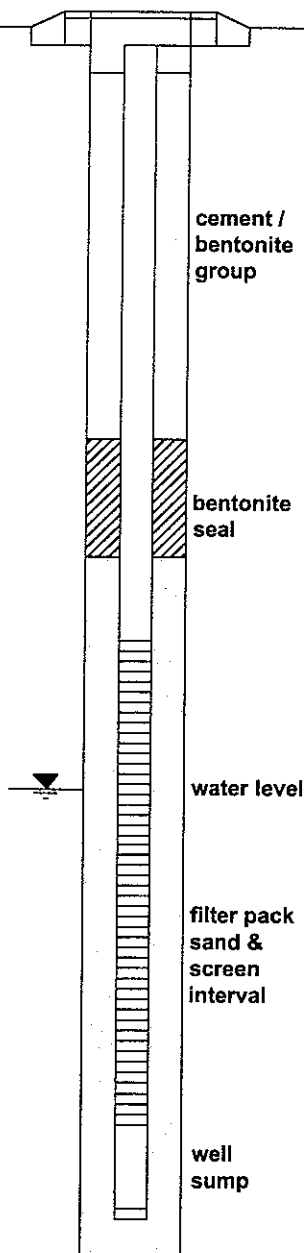
Ground Surface Elevation 399.48
 Measure Point Elevation 399.20
 Measure Point top of casing (TOC)
 Encountered Water During Drilling approx. 33 ft. bgs
 Static Water Level (Date) 27.61 ft. TOC (11/16/99)

DRILLING SUMMARY

Drilling Method hollow stem auger (HSA)
 Borehole Depth, Diameter 0 to 43 ft., 10-inch HSA
 Total Drilled Depth 43 ft.
 Comments used limited access HSA rig for
drilling and well installation

WELL CONSTRUCTION

Total Well Depth 41 ft.
 Plug-back Interval none
 Casing Type, Diameter Sch. 40 PVC, 4-inch
 Screen Type, Diameter Sch. 40 PVC, 4-inch
 Screen Slot Size 0.010-inch, factory slotted
 Sump, Bottom Cap 2-foot blank casing, threaded end cap
 Filter Pack Material # 2/16 Lapis Luster sand
 Well Seal Material bentonite chips
 Grout Material Portland cement & powdered bentonite
 Conductor Casing none
 Centralizers none
 Surface Completion flush-set 8-inch diam. well box
 Comments added approx. 50 gallons water to
borehole to facilitate well construction



Not To Scale

Project: Los Angeles NMCRC Site Inspection
 Project No: 6210-024-FDI-SRV
 Location: Background, southwest-side Admin. Bldg.
 Construction Date: Nov. 4, 1999
 Prepared By: PFB

WELL CONSTRUCTION SUMMARY

Well Type Monitoring Well Well No. MW - 03

WELL CONSTRUCTION DETAIL

Depth
feet below surface

Ground Surface Elevation 401.48
 Measure Point Elevation 400.71
 Measure Point top of casing (TOC)
 Encountered Water During Drilling approx. 34 ft. bgs
 Static Water Level (Date) 28.65 ft. TOC (11/15/99)

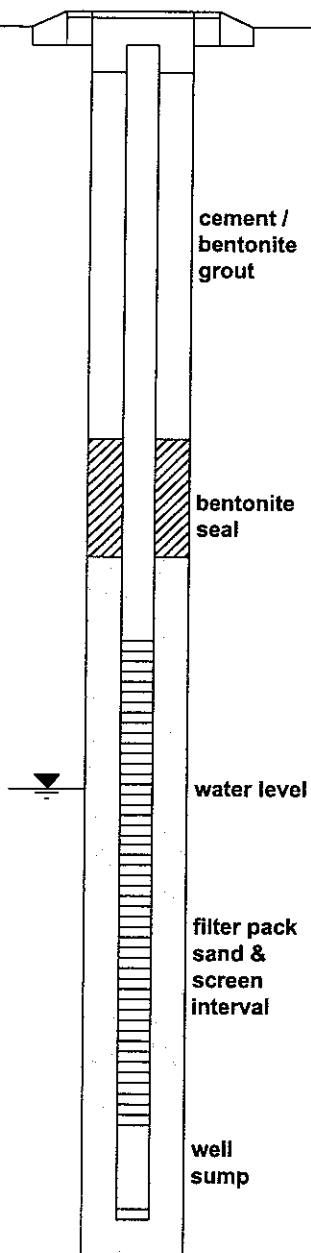
DRILLING SUMMARY

Drilling Method hollow stem auger (HSA)
 Borehole Depth, Diameter 0 to 43 ft., 10-inch HSA
 Total Drilled Depth 43 ft.
 Comments _____

WELL CONSTRUCTION

Total Well Depth 42.5 ft.
 Plug-back Interval none
 Casing Type, Diameter Sch. 40 PVC, 4-inch
 Screen Type, Diameter Sch. 40 PVC, 4-inch
 Screen Slot Size 0.010-inch, factory slotted
 Sump, Bottom Cap 2-foot blank casing, threaded end cap
 Filter Pack Material # 2/16 Lapis Luster sand
 Well Seal Material bentonite chips
 Grout Material Portland cement & powdered bentonite
 Conductor Casing none
 Centralizers none
 Surface Completion flush-set 12-inch diam. well box

Comments _____



Not To Scale

Project: Los Angeles NMCRC Site Inspection		WELL CONSTRUCTION SUMMARY	
Project No: 6210-024-FDI-SRV			
Location: Background, south-side Admin. Bldg.			
Construction Date: Nov. 8, 1999			
Prepared By: PFB		Well Type <u>Monitoring Well</u> Well No. <u>MW - 4B</u>	
WELL CONSTRUCTION DETAIL		Ground Surface Elevation <u>402.57</u> Measure Point Elevation <u>402.28</u> Measure Point <u>top of casing (TOC)</u> Encountered Water During Drilling <u>approx. 30 ft. bgs</u> Static Water Level (Date) <u>30.08 ft. TOC (11/10/99)</u>	
		DRILLING SUMMARY	
		Drilling Method <u>hollow stem auger (HSA)</u> Borehole Depth, Diameter <u>0 to 41 ft, 10-inch HSA</u> Total Drilled Depth <u>41 ft.</u> Comments <u>boring/well MW-4B is located next to soil</u> <u>boring DP-4 (drilled and logged to 35' 11/3/99)</u>	
		WELL CONSTRUCTION	
Not To Scale		Total Well Depth <u>40.5 ft.</u> Plug-back Interval <u>none</u> Casing Type, Diameter <u>Sch. 40 PVC, 4-inch</u> Screen Type, Diameter <u>Sch. 40 PVC, 4-inch</u> Screen Slot Size <u>0.010-inch, factory slotted</u> Sump, Bottom Cap <u>2-foot blank casing, threaded end cap</u> Filter Pack Material <u># 2/16 Lapis Luster sand</u> Well Seal Material <u>bentonite chips</u> Grout Material <u>Portland cement & powdered bentonite</u> Conductor Casing <u>none</u> Centralizers <u>none</u> Surface Completion <u>flush-set 12-inch diam. well box</u> Comments _____ _____ _____	

Project: Los Angeles NMCRC Site Inspection	
Project No: 6210-024-FDI-SRV	
Location: south end, main level parking area	
Construction Date: Nov. 5, 1999	
Prepared By: PFB	

WELL CONSTRUCTION SUMMARY

Well Type Monitoring Well Well No. MW - 05

WELL CONSTRUCTION DETAIL

Depth
feet below surface

Ground Surface Elevation 391.87
 Measure Point Elevation 391.52
 Measure Point top of casing (TOC)
 Encountered Water During Drilling approx. 26 ft. bgs
 Static Water Level (Date) 20.98 ft. TOC (11/10/99)

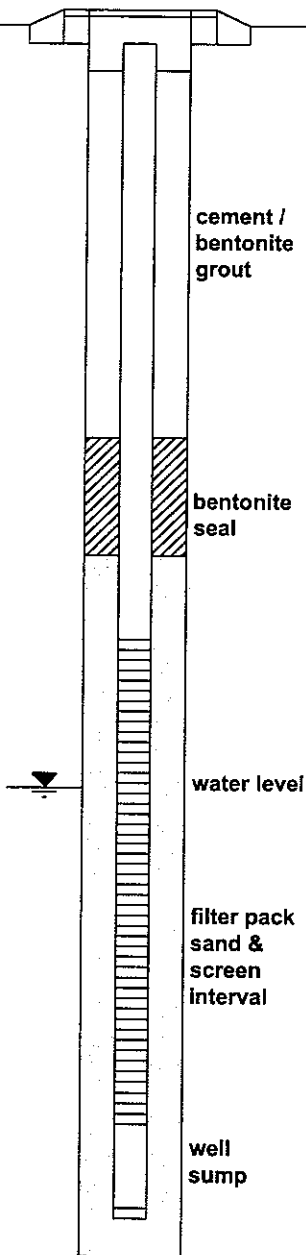
DRILLING SUMMARY

Drilling Method hollow stem auger (HSA)
 Borehole Depth, Diameter 0 to 36 ft., 10-inch HSA
 Total Drilled Depth 36 ft.
 Comments _____

WELL CONSTRUCTION

Total Well Depth 34.5 ft.
 Plug-back Interval none
 Casing Type, Diameter Sch. 40 PVC, 4-inch
 Screen Type, Diameter Sch. 40 PVC, 4-inch
 Screen Slot Size 0.010-inch, factory slotted
 Sump, Bottom Cap 2-foot blank casing, threaded end cap
 Filter Pack Material # 2/16 Lapis Luster sand
 Well Seal Material bentonite chips
 Grout Material Portland cement & powdered bentonite
 Conductor Casing none
 Centralizers none
 Surface Completion flush-set 12-inch diam. well box

Comments _____



Not To Scale

Project: Los Angeles NMCRC Site Inspection	
Project No: 6210-024-FDI-SRV	
Location: downgradient at property line	
Construction Date: Jan. 25, 2000	
Prepared By: PFB	

WELL CONSTRUCTION SUMMARY

Well Type Monitoring Well Well No. MW - 06

WELL CONSTRUCTION DETAIL

Depth
feet below surface

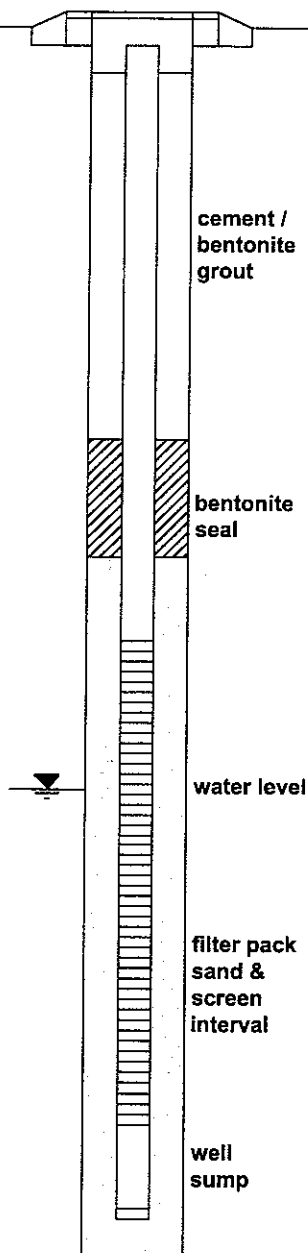
Ground Surface Elevation 389.84
 Measure Point Elevation 389.52
 Measure Point top of casing (TOC)
 Encountered Water During Drilling approx. 34 ft. bgs
 Static Water Level (Date) 21.83 ft. TOC (1/27/00)

DRILLING SUMMARY

Drilling Method hollow stem auger (HSA)
 Borehole Depth, Diameter 0 to 38 ft., 10-inch HSA
 Total Drilled Depth 38 ft.
 Comments Very slow water entry after
drilling to total depth (clayey soils)

WELL CONSTRUCTION

Total Well Depth 36.0 ft.
 Plug-back Interval none
 Casing Type, Diameter Sch. 40 PVC, 4-inch
 Screen Type, Diameter Sch. 40 PVC, 4-inch
 Screen Slot Size 0.010-inch, factory slotted
 Sump, Bottom Cap 2-foot blank casing, threaded end cap
 Filter Pack Material # 2/16 Lapis Luster sand
 Well Seal Material bentonite chips
 Grout Material Portland cement & powdered bentonite
 Conductor Casing none
 Centralizers none
 Surface Completion flush-set 12-inch diam. well box
 Comments well screen was dry during
well construction (low recharge)



Not To Scale

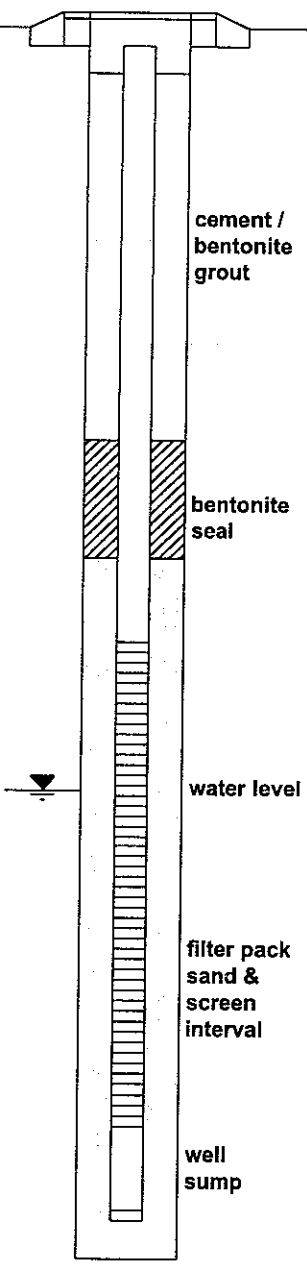
Project: Los Angeles NMCRC Site Inspection
 Project No: 6210-024-FDI-SRV
 Location: downgradient of Lube Rack area
 Construction Date: Jan. 24, 2000
 Prepared By: PFB

WELL CONSTRUCTION SUMMARY

Well Type Monitoring Well Well No. MW - 07

WELL CONSTRUCTION DETAIL

Depth
feet below surface



Ground Surface Elevation 393.44
 Measure Point Elevation 393.10
 Measure Point top of casing (TOC)
 Encountered Water During Drilling approx. 30 ft. bgs
 Static Water Level (Date) 22.68 ft. TOC (1/27/00)

DRILLING SUMMARY

Drilling Method hollow stem auger (HSA)
 Borehole Depth, Diameter 0 to 37 ft., 10-inch HSA
 Total Drilled Depth 37 ft.
 Comments Very slow water entry after
drilling to total depth (clayey soils)

WELL CONSTRUCTION

Total Well Depth 36.5 ft.
 Plug-back Interval none
 Casing Type, Diameter Sch. 40 PVC, 4-inch
 Screen Type, Diameter Sch. 40 PVC, 4-inch
 Screen Slot Size 0.010-inch, factory slotted
 Sump, Bottom Cap 2-foot blank casing, threaded end cap
 Filter Pack Material # 2/16 Lapis Luster sand
 Well Seal Material bentonite chips
 Grout Material Portland cement & powdered bentonite
 Conductor Casing none
 Centralizers none
 Surface Completion flush-set 12-inch diam. well box
 Comments _____

Not To Scale

Appendix E
Groundwater Sampling Logs

GROUNDWATER MONITORING WELL PURGING AND SAMPLING LOG

PROJECT NO.: 6210-024				SAMPLE LOCATION: MWD1				
PROJECT NAME: NMCRC-LA SI				SAMPLE ID: 99RC-MWD1-W-1-27				
DATE: 11-16-99				SAMPLED BY: M. Brookshire/ B. Trihn				
EQUIPMENT DECONTAMINATED: YES				PURGE START TIME: 1308				
PURGING METHOD: 2-INCH SUBMERSIBLE GRUNDFOS PUMP								
SAMPLING EQUIPMENT: DISPOSABLE TEFLON BAILER								
6" DIAMETER WELL = 1.5 gal/ft			4" DIAMETER WELL = 0.67 gal/ft			2' DIAMETER = 0.17 gal/ft		
Casing inner-diameter (a) = 4 inches				Unit Casing Volume (b) = 0.67				
Depth to Well Bottom (c): 40'				Depth to Water (d) (measured from TOC): 26.14'				
Length of Static Water Column (e) = (c) - (d) = 13.86								
Casing Volume (f) = (b) x (e) = 9.29								
Total Purge Volume (g) = 3 casing volumes x (f) = 27.9								
Actual Time	Volume Purged	Temperature	pH	Conductance MS/cm MS/cm	Dissolved oxygen	ORP	Turbidity NTu	Description
1313 1308	5	22.94	7.2	3.40	12.9	44.7	2.9	clear
1318	10	23.17	6.77	3.39	10.7	73.0	3.8	clear
1323	15	23.16	6.67	3.34	8.64	75.6	6.5	clear
1328	20	23.17	6.61	3.33	7.33	77.9	7.5	clear
1331	23	23.16	6.64	3.36	6.43	76.4	4.9	clear
1334	26	23.16	6.61	3.36	6.33	81.8	4.1	clear
1337	29	23.12	6.58	3.34	5.74	78.0	3.2	clear
1338	Stop							
Total Volume Purged: 30								
Total Time: 30 minutes								
Purged Dry? (Yes/No): No								
Laboratory Analysis: VOCs (✓) SVOCs (✓) PCBs (✓) Metals (✓) Metals Filtered (✓)								
pH (✓) Organic Lead (✓) TPH gas (✓) TPH diesel (✓) Dissolved gases (✓) Anions (✓)								
Total sulfide (✓) TKN (✓) Ammonia (✓) IDS (✓) Alkalinity (✓)								
Total number of bottles: 28								
Comments: MS/MSD. Field in situ tests were negative								

GROUNDWATER MONITORING WELL PURGING AND SAMPLING LOG

PROJECT NO.: 6210-024	SAMPLE LOCATION: MW02
PROJECT NAME: NMCRC-LA SI	SAMPLE ID: 99RC-MW02-W-1-28
DATE: 11-16-99	SAMPLED BY: M. Brookshire/ B. Trihn
EQUIPMENT DECONTAMINATED: YES	PURGE START TIME: 1045

PURGING METHOD: 2-INCH SUBMERSIBLE GRUNDFOS PUMP

SAMPLING EQUIPMENT: DISPOSABLE TEFLON BAILER

6" DIAMETER WELL = 1.5 gal/ft	4" DIAMETER WELL = 0.67 gal/ft	2" DIAMETER = 0.17 gal/ft
Casing inner-diameter (a) = 4 inches	Unit Casing Volume (b) = 0.67	
Depth to Well Bottom (c): 41.0'	Depth to Water (d) (measured from TOC): 27.61'	
Length of Static Water Column (e) = (c) - (d) = 13.4		
Casing Volume (f) = (b) x (e) = 8.97		
Total Purge Volume (g) = 3 casing volumes x (f) = 26.9		

Actual Time	Volume Purged	Temperature	pH	Conductance mS (SM) mS/cm	Dissolved oxygen	ORP	Turbidity NTu	Description
1057	5	23.39	7.10	2.94	11.68	66.3	97.2	slightly cloudy
1109	10	23.69	6.86	3.03	5.93	92.5	1192	cloudy
1125	15	25.02	6.88	3.08	5.36	80.1	1421	very cloudy
1131	18	24.28	6.69	3.01	4.88	97.1	1079	very cloudy
1136	stopped purging - well dry							
1151	resume purging							
1200	21	23.95	6.80	2.99	5.30	95.3	134	clear
1206	24	24.21	6.65	2.97	5.12	114.3	117	slightly cloudy
1206	well dry							

Total Volume Purged: 24	Total Time: 66 minutes	Purged Dry? (Yes/No): Yes
Laboratory Analysis: VOCs (✓) SVOCs (✓) PCBs (✓) Metals (✓) Metals Filtered (✓) pH (✓) Organic Lead (✓) TPH gas (✓) TPH diesel (✓) Dissolved gases (✓) Anions (✓) Total sulfide (✓) IKN (✓) Ammonia (✓) TDS (✓) Alkalinity (✓)		

Total number of bottles: 15

Comments: Duplicate collected 99RC-MW02-W-3-28. Field
 in II tests were negative.

GROUNDWATER MONITORING WELL PURGING AND SAMPLING LOG

PROJECT NO.: 6210-024				SAMPLE LOCATION: MW03				
PROJECT NAME: NMCRC-LA SI				SAMPLE ID: 99RC-MW03-W-1-29				
DATE: 11-15-99				SAMPLED BY: M. Brookshire/ B. Trihn				
EQUIPMENT DECONTAMINATED: YES				PURGE START TIME: 1600				
PURGING METHOD: 2-INCH SUBMERSIBLE GRUNDFOS PUMP								
SAMPLING EQUIPMENT: DISPOSABLE TEFLON BAILER								
6" DIAMETER WELL = 1.5 gal/ft			4" DIAMETER WELL = 0.67 gal/ft			2" DIAMETER = 0.17 gal/ft		
Casing inner-diameter (a) = 4 inches				Unit Casing Volume (b) = 0.67				
Depth to Well Bottom (c): 42.5'				Depth to Water (d) (measured from TOC): 28.65'				
Length of Static Water Column (e) = (c) - (d) = 13.85'								
Casing Volume (f) = (b) x (e) = 9.28								
Total Purge Volume (g) = 3 casing volumes x (f) = 27.8								
Actual Time	Volume Purged	Temperature	pH	Conductance (S/M) (mS/cm)	Dissolved oxygen	ORP	Turbidity NTu	Description
1607	5	22.40	7.40	1.63	2.35	169.7	164.9	cloudy
1618	10	23.74	7.18	1.88	1.26	155.6	121.7	cloudy
1630	15	23.95	7.21	1.90	1.47	146.5	102.6	murky
1645	20	23.68	6.99	1.73	1.60	149.9	105.1	murky, sediment
1655	25	23.51	7.15	1.76	1.49	100.3	63.5	cloudy
1700	29	23.72	7.25	1.83	1.82	104.9	94.5	cloudy
1702	stop							
Total Volume Purged: 30		Total Time: 62 minutes				Purged Dry? (Yes/No): No		
Laboratory Analysis: VOCs (✓) SVOCs () PCBs () Metals (✓) Metals Filtered (✓)								
pH (✓) Organic Lead (✓) TPH gas (✓) TPH diesel (✓) Dissolved gases (✓) Anions (✓)								
Total sulfide (✓) IKN (✓) Ammonia (✓) IDS (✓) Alkalinity (✓)								
Total number of bottles: 2MB, 13								
Comments: Sample was collected on 11-16-99 due to the lack of light on 11-15-99 after purging was completed. Field in situ tests were negative.								

GROUNDWATER MONITORING WELL PURGING AND SAMPLING LOG

PROJECT NO.: 6210-024				SAMPLE LOCATION: MW04B				
PROJECT NAME: NMCRC-LA SI				SAMPLE ID: 99RC-MW04B-W-1-30				
DATE: 11-16-99				SAMPLED BY: M. Brookshire/ B. Trihn				
EQUIPMENT DECONTAMINATED: YES				PURGE START TIME: 0905				
PURGING METHOD: 2-INCH SUBMERSIBLE GRUNDFOS PUMP								
SAMPLING EQUIPMENT: DISPOSABLE TEFLON BAILER								
6" DIAMETER WELL = 1.5 gal/ft			4" DIAMETER WELL = 0.67 gal/ft			2' DIAMETER = 0.17 gal/ft		
Casing inner-diameter (a) = 4 inches				Unit Casing Volume (b) = 0.67				
Depth to Well Bottom (c): 40.5'				Depth to Water (d) (measured from TOC): 30.18'				
Length of Static Water Column (e) = (c) - (d) = 10.32'								
Casing Volume (f) = (b) x (e) = 6.9								
Total Purge Volume (g) = 3 casing volumes x (f) = 20.7								
Actual Time	Volume Purged	Temperature	pH	Conductance (S/M) (µS/cm)	Dissolved oxygen	ORP	Turbidity NTu	Description
0915	5	22.79	6.62	1.84	11.4	138.3	23.0	clear
0922	10	23.78	6.76	1.71	6.82	134.7	59.8	clear
0931	14	23.96	6.86	1.61	5.01	128.1	34.1	clear
0939	18	23.95	6.83	1.57	4.66	137.6	21.8	clear
0946	22	23.79	6.79	1.56	4.15	152.3	51.6	clear
0948	stop							
Total Volume Purged: 23		Total Time: 43			Purged Dry? (Yes/No): No			
Laboratory Analysis: VOCs (✓) SVOCs () PCBs () Metals (✓) Metals Filtered (✓) pH (✓) Organic Lead (✓) TPH gas (✓) TPH diesel (✓) Dissolved gases () Anions () Total sulfide () TKN () Ammonia () TDS () Alkalinity ()								
Total number of bottles: 9								
Comments: Field ion tests were negative.								

GROUNDWATER MONITORING WELL PURGING AND SAMPLING LOG

PROJECT NO : 6210-024				SAMPLE LOCATION: MW05				
PROJECT NAME: NMCRC-LA SI				SAMPLE ID: 99RC-MW05-W-1-22				
DATE: 11-15-00				SAMPLED BY: M. Brookshire/ B. Trihn				
EQUIPMENT DECONTAMINATED: YES				PURGE START TIME: 1415				
PURGING METHOD: 2-INCH SUBMERSIBLE GRUNDFOS PUMP								
SAMPLING EQUIPMENT: DISPOSABLE TEFLON BAILER								
6" DIAMETER WELL = 1.5 gal/ft			4" DIAMETER WELL = 0.67 gal/ft			2' DIAMETER = 0.17 gal/ft		
Casing inner-diameter (a) = 4 inches				Unit Casing Volume (b) = 0.67				
Depth to Well Bottom (c): 34.5'				Depth to Water (d) (measured from TOC): 21.05'				
Length of Static Water Column (e) = (c) - (d) = 13.45'								
Casing Volume (f) = (b) x (e) = 9.01								
Total Purge Volume (g) = 3 casing volumes x (f) = 27.03								
Actual Time	Volume Purged	Temperature	pH	Conductance (S/M) (mS/cm)	Dissolved oxygen	ORP	Turbidity NTu	Description
1420	5	23.14	6.2	4.37	4.27	174.6	16.0	clear
1426	10	22.85	6.86	4.45	9.24	129.7	14.3	clear
1431	15	23.30	6.58	4.47	5.28	135.4	7.77	clear
1436	19	23.40	6.44	4.50	3.69	137.9	6.10	clear
1441	23	23.54	6.20	4.51	6.98	446.0	5.02	clear
1447	28	23.55	6.25	4.51	2.94	449.3	3.92	clear
1451	stop							
Total Volume Purged: 32		Total Time: 36 minutes			Purged Dry? (Yes/No): No			
Laboratory Analysis: VOCs (✓) SVOCs () PCBs () Metals (✓) Metals Filtered (✓) pH (✓) Organic Lead (✓) IPH gas (✓) IPH diesel (✓) Dissolved gases () Anions () Total sulfide () TKN () Ammonia () IDS () Alkalinity ()								
Total number of bottles: 9								
Comments: Field iron II tests were negative.								

GROUNDWATER MONITORING WELL PURGING AND SAMPLING LOG

PROJECT NO.: 6210-024	SAMPLE LOCATION: MW01
PROJECT NAME: NMCRC-LA SI	SAMPLE ID: DORC-MW01-W-1-27
DATE: 1-31-00	SAMPLED BY: M. Brookshire/ B. Trihn
EQUIPMENT DECONTAMINATED: YES	PURGE START TIME: 1332

PURGING METHOD: 2-INCH SUBMERSIBLE GRUNDFOS PUMP

SAMPLING EQUIPMENT: DISPOSABLE TEFLON BAILER

6" DIAMETER WELL = 1.5 gal/ft 4" DIAMETER WELL = 0.67 gal/ft 2" DIAMETER = 0.17 gal/ft

Casing inner-diameter (a) = 4 inches Unit Casing Volume (b) = 0.67

Depth to Well Bottom (c): 40.0' Depth to Water (d) (measured from TOC): 26.90'

Length of Static Water Column (e) = (c) - (d) = 13.1

Casing Volume (f) = (b) x (e) = 8.79

Total Purge Volume (g) = 3 casing volumes x (f) = 26.3

Actual Time	Volume Purged	Temperature	pH	Conductance (S/M)	Dissolved oxygen	ORP	Turbidity NTu	Description
1337	5	21.5	6.76	0.25	2.70	450	1.6	clear
1342	10	22.3	6.88	0.25	2.78	445	2.7	clear
1347	15	22.1	6.90	0.25	2.87	443	3.7	clear
1350	18	22.3	6.92	0.25	3.95	444	1.2	clear
1353	21	22.1	6.93	0.25	3.80	443	1.6	clear
1356	24	22.5	6.90	0.25	3.95	443	2.0	clear
1400	27	22.4	6.89	0.25	3.89	443	1.4	clear
1401	stop							

Total Volume Purged: 28 Total Time: 29 minutes Purged Dry? (Yes/No): NO

Laboratory Analysis: VOCs (✓) SVOCs (✓) PCBs (✓) Metals (✓) Metals Filtered (✓)
 pH (✓) Organic Lead (✓) TPH gas (✓) TPH diesel (✓) Dissolved gases (✓) Anions (✓)
 Total sulfide (✓) IKN (✓) Ammonia (✓) IDS (✓) Alkalinity (✓)

Total number of bottles: 16

Comments: Field inn II tests were negative.

GROUNDWATER MONITORING WELL PURGING AND SAMPLING LOG

PROJECT NO.: 6210-024				SAMPLE LOCATION: MW02				
PROJECT NAME: NMCRC-LA SI				SAMPLE ID: 60RC-MW02-W-1-28				
DATE: 2-1-00				SAMPLED BY: M. Brookshire/ B. Trihn				
EQUIPMENT DECONTAMINATED: <input checked="" type="checkbox"/> YES				PURGE START TIME: 1238				
PURGING METHOD: 2-INCH SUBMERSIBLE GRUNDFOS PUMP								
SAMPLING EQUIPMENT: DISPOSABLE TEFLON BAILER								
6" DIAMETER WELL = 1.5 gal/ft			4" DIAMETER WELL = 0.67 gal/ft			2" DIAMETER = 0.17 gal/ft		
Casing inner-diameter (a) = 4 inches				Unit Casing Volume (b) = 0.67				
Depth to Well Bottom (c): 41.0				Depth to Water (d) (measured from TOC): 28.37				
Length of Static Water Column (e) = (c) - (d) =				12.63				
Casing Volume (f) = (b) x (e) =				8.46				
Total Purge Volume (g) = 3 casing volumes x (f) =				25.4				
Actual Time	Volume Purged	Temperature	pH	Conductance (S/M)	Dissolved oxygen	ORP	Turbidity NTu	Description
1246	4	22.5	6.74	0.23	3.43	463	17.5	clear
1303	8	23.3	6.79	0.22	3.10	443	517	cloudy
1318	12	22.0	7.05	0.23	4.47	447	555	cloudy
1326	stop							
Total Volume Purged: 15			Total Time: 48 minutes			Purged Dry? (Yes/No): Yes		
Laboratory Analysis: VOCs (✓) SVOCs (✓) PCBs (✓) Metals (✓) Metals Filtered (✓) pH (✓) Organic Lead (✓) TPH gas (✓) TPH diesel (✓) Dissolved gases (✓) Anions (✓) Total sulfide (✓) IKN (✓) Ammonia (✓) IDS (✓) Alkalinity (✓)								
Total number of bottles: 16								
Comments: Field iron II tests were negative.								

GROUNDWATER MONITORING WELL PURGING AND SAMPLING LOG

PROJECT NO.: 6210-024				SAMPLE LOCATION: MW05				
PROJECT NAME: NMCRC-LA SI				SAMPLE ID: BDRCMW05-W-1-22				
DATE: 1-31-00				SAMPLED BY: M. Brookshire/ B. Trihn				
EQUIPMENT DECONTAMINATED: YES				PURGE START TIME: 1540				
PURGING METHOD: 2-INCH SUBMERSIBLE GRUNDFOS PUMP								
SAMPLING EQUIPMENT: DISPOSABLE TEFLON BAILER								
6" DIAMETER WELL = 1.5 gal/ft			4" DIAMETER WELL = 0.67 gal/ft			2" DIAMETER = 0.17 gal/ft		
Casing inner-diameter (a) = 4 inches				Unit Casing Volume (b) = 0.67				
Depth to Well Bottom (c): 34.5'				Depth to Water (d) (measured from TOC): 21.70'				
Length of Static Water Column (e) = (c) - (d) = 12.8								
Casing Volume (f) = (b) x (e) = 8.58								
Total Purge Volume (g) = 3 casing volumes x (f) = 25.7								
Actual Time	Volume Purged	Temperature	pH	Conductance (S/M)	Dissolved oxygen	ORP	Turbidity NTu	Description
1545	5	21.5	6.74	0.37	3.71	466	8.5	Clear
1548	10	21.6	6.84	0.37	4.58	463	8.4	Clear
1553	15	21.7	6.77	0.39	4.04	461	4.1	Clear
1556	18	22.0	6.72	0.39	4.01	458	3.4	Clear
1559	21	22.0	6.70	0.39	2.97	455	3.6	Clear
1604	26	21.4	6.76	0.39	4.62	454	2.5	Clear
1607	Stop							
Total Volume Purged: 28			Total Time: 27			Purged Dry? (Yes/No): No		
Laboratory Analysis: VOCs (✓) SVOCs (✓) PCBs (✓) Metals (✓) Metals Filtered (✓) pH (✓) Organic Lead (✓) TPH gas (✓) TPH diesel (✓) Dissolved gases (✓) Anions (✓) Total sulfide (✓) TKN () Ammonia (✓) IDS (✓) Alkalinity (✓)								
Total number of bottles: 10								
Comments: Field iron II tests were negative.								

GROUNDWATER MONITORING WELL PURGING AND SAMPLING LOG

PROJECT NO.: 6210-024				SAMPLE LOCATION: MW06				
PROJECT NAME: NMCRC-LA SI				SAMPLE ID: OORC-MW06-W-1-22				
DATE: 2-1-00				SAMPLED BY: M. Brookshire/ B. Trihn				
EQUIPMENT DECONTAMINATED: YES				PURGE START TIME: 0814				
PURGING METHOD: 2-INCH SUBMERSIBLE GRUNDFOS PUMP								
SAMPLING EQUIPMENT: DISPOSABLE TEFLON BAILER								
6" DIAMETER WELL = 1.5 gal/ft			4" DIAMETER WELL = 0.67 gal/ft			2' DIAMETER = 0.17 gal/ft		
Casing inner-diameter (a) = 4 inches				Unit Casing Volume (b) = 0.67				
Depth to Well Bottom (c): 36.0				Depth to Water (d) (measured from TOC): 22.0				
Length of Static Water Column (e) = (c) - (d) = 14.0								
Casing Volume (f) = (b) x (e) = 9.38								
Total Purge Volume (g) = 3 casing volumes x (f) = 28.14								
Actual Time	Volume Purged	Temperature	pH	Conductance (S/M)	Dissolved oxygen	ORP	Turbidity NTu	Description
0820	3	20.6	6.98	0.37	4.25	441	10.4	Clear
0827	6	20.6	7.13	0.38	5.44	433	86.5	Cloudy
0836	9	20.9	7.19	0.38	5.35	432	87.6	Cloudy
0844	12	21.9	7.25	0.39	4.96	430	29.2	Clear
0850	15	21.4	7.36	0.39	5.90	429	34.2	Clear
0854	17	stop						
Total Volume Purged: 17		Total Time: 40			Purged Dry? (Yes/No): Yes			
Laboratory Analysis: VOCs (+) SVOCs (-) PCBs (-) Metals (-) Metals Filtered (+)								
pH (+) Organic Lead (+) TPH gas (+) TPH diesel (+) Dissolved gases (+) Anions (+)								
Total sulfide (+) TKN (+) Ammonia (+) TDS (+) Alkalinity (+)								
Total number of bottles: 16								
Comments: Allowed well to recharge prior to sampling. Field ion II tests were negative								

GROUNDWATER MONITORING WELL PURGING AND SAMPLING LOG

PROJECT NO.: 6210-024				SAMPLE LOCATION: MW07				
PROJECT NAME: NMCRC-LA SI				SAMPLE ID: 00RC-MW07-W-1-23				
DATE: 2-1-00				SAMPLED BY: M. Brookshire/ B. Trihn				
EQUIPMENT DECONTAMINATED: YES				PURGE START TIME: 0925				
PURGING METHOD: 2-INCH SUBMERSIBLE GRUNDFOS PUMP								
SAMPLING EQUIPMENT: DISPOSABLE TEFLON BAILER								
6" DIAMETER WELL = 1.5 gal/ft			4" DIAMETER WELL = 0.67 gal/ft			2" DIAMETER = 0.17 gal/ft		
Casing inner-diameter (a) = 4 inches				Unit Casing Volume (b) = 0.67				
Depth to Well Bottom (c): 36.5				Depth to Water (d) (measured from TOC): 22.69				
Length of Static Water Column (e) = (c) - (d) =				13.81				
Casing Volume (f) = (b) x (e) =				9.25				
Total Purge Volume (g) = 3 casing volumes x (f) =				27.8				
Actual Time	Volume Purged	Temperature	pH	Conductance (S/M)	Dissolved oxygen	ORP	Turbidity NTu	Description
0933	4	21.1	6.93	0.43	5.78	449	27.6	clear
0940	8	21.5	6.88	0.42	4.66	448	27.0	clear
0945	12	21.9	6.88	0.43	5.10	448	35.3	clear
0949	16	21.8	6.87	0.42	5.21	447	34.4	clear
0953	20	22.0	6.88	0.43	5.10	447	32.1	clear
0957	24	22.3	6.87	0.42	5.66	447	26.7	clear
1001	28	22.4	6.87	0.42	6.13	446	20.6	clear
1003	stopped							
Total Volume Purged: 29			Total Time: 38 minutes			Purged Dry? (Yes/No): No		
Laboratory Analysis: VOCs (✓) SVOCs (✓) PCBs (✓) Metals (✓) Metals Filtered (✓)								
pH (✓) Organic Lead (✓) TPH gas (✓) TPH diesel (✓) Dissolved gases (✓) Anions (✓)								
Total sulfide (✓) TKN (✓) Ammonia (✓) IDS (✓) Alkalinity (✓)								
Total number of bottles: 29								
Comments: ms/msd. Field iron II test were negative								

WELL DEVELOPMENT RECORD

Project Name NMCRC Los Angeles Well No. MW-1
 Project Number 6210-024-FDI-SRV Well Depth 40'
 Well Development Date 11/9/99 Screen Interval 22.5 - 37.5'
 Drilling Subcontractor Spectrum Exploration Casing Diameter 4" Sch. 40
 Development Method Surge & Seal Casing Vol Factor 0.67 gal./foot
 Equipment Used Surge block & 6' bitbar Initial Water Level / Time 26.4' bgs 13.6' water column
 Comments (2.5 gal. / min.) 1 Casing Volume 9.1 gallons

Activity	Time	Depth to Water (feet TOC)	Gallons Recovered	Field Parameters				Remarks
				Temperature	pH	Conductivity	Other	
Test Well	14:15	26.04						
Surge & Seal	14:20							
Surge & Seal	14:32							
Surge & Seal	14:38							
Surge & Seal	14:52	31.42	21.7	21.99	7.23	3.754		13.6' water column
Surge & Seal	15:02							
Surge & Seal	15:10		37.20	21.77	7.17	3.754		
Surge & Seal	15:22	18.45						
Surge & Seal	15:32		40.00	22.11	7.14	3.754		13.6' water column
Surge & Seal	15:39		48.90	22.21	7.14	3.754		13.6' water column
Surge & Seal	15:31		37.40	21.77	7.17	3.754		
Surge & Seal	15:37		47.00	21.36	7.10	3.754		
Surge & Seal	15:42		48.90	21.70	7.15	3.754		
Surge & Seal	15:46		48.90	21.20	7.15	3.754		
Surge & Seal	15:48		70.00	21.77	7.17	3.754		
Surge & Seal	15:51	18.45						

Total Gallons Removed

70 gallons

Total Casing Volumes

~8

Notes & Comments

13.6' water column

WELL DEVELOPMENT RECORD

Project Name <u>NMCRK Los Angeles</u>	Well No. <u>MWD2</u>
Project Number <u>E210-024-FDI-SRV</u>	Well Depth <u>41.0'</u>
Well Development Date <u>11-11-99</u>	Screen Interval <u>23.5' - 38.5'</u>
Drilling Subcontractor <u>Spectrum Exploration</u>	Casing Diameter <u>4" Sch. 40 PVC</u>
Development Method <u>Surge block</u>	Casing Vol Factor <u>0.67 gal./foot</u>
Equipment Used <u>6' bailer (2.5 gal.)</u>	Initial Water Level / Time <u>26.85'</u> Water Column
Staff / Comments <u>and</u>	1 Casing Volume <u>9.48 gallons</u>

Activity	Time	Depth to Water (feet TOC)	Gallons Recovered	Field Parameters				Remarks
				Temperature °C	pH	Conductivity	Other Turbidity	
Begin surging	0916							
Finish surging	0935							OVM = 37.4 ppm
129.1 bailing	0937							
	0945		10	22.75	6.47	2.67		turbid OVM = 5.5 ppm
	1034		20	22.54	7.37	3.04		turbid
WL	1036	40.81'						OVM 29.7 ppm
	1111		30	22.82	7.38	3.00		turbid
	1154		36	22.88	7.50	2.95	510	turbid OVM = 52 ppm
WL	1200	39.05'						
	1233		40	22.96	7.71	2.93	159	turbid OVM = 32 ppm
	1306		43	22.92	7.83	2.94	210	turbid OVM = 39 ppm
WL	1313	39.70'						

Total Gallons Removed _____

Total Casing Volumes _____

Notes & Comments 1007, 1036, 1112, 1156, 1235
0947 - well dry - allow to recharge

WELL DEVELOPMENT RECORD

Project Name NMCRRC Los Angeles
Project Number E210-024-FDI-SK V
Well Development Date 11/10/99
Drilling Subcontractor Spectrum Exploration
Development Method Surge block
Equipment Used 6" bailer (2.5 gal)
Staff / Comments

Well No.	MWD3
Well Depth	42.5'
Screen Interval	25'-40'
Casing Diameter	4" Sch. 40 PVC
Casing Vol Factor	0.67 gal./foot
Initial Water Level / Time	28.45'
1 Casing Volume	9.5

Water Column

[illegible]

Total Gallons Removed 35

Total Casing Volumes 24

Notes & Comments: Water was still turbid after 2 hours of development.

WELL DEVELOPMENT RECORD

Project Name <u>NMCRCLos Angeles</u>	Well No. <u>MW04B</u>
Project Number <u>E210-024-FDI-SRV</u>	Well Depth <u>40.5'</u>
Well Development Date <u>11-10-99</u>	Screen Interval <u>23-38'</u>
Drilling Subcontractor <u>Spectrum Exploration</u>	Casing Diameter <u>4" Sch. 40 PVC</u>
Development Method <u>surge block</u>	Casing Vol Factor <u>0.67 gal./foot</u>
Equipment Used <u>6' bailer (2.5 gal)</u>	Initial Water Level / Time <u>30.08</u> Water Column
Staff / Comments <u>MB</u>	1 Casing Volume <u>7.08</u>

Activity	Time	Depth to Water (feet TOC)	Gallons Recovered	Field Parameters				Remarks
				Temperature °C	pH	Conductivity	Other Turbidity	
Begin surging	1300							
Finish surging	1312							
Begin Bailer	1314							
	1321		10	23.17	7.84	4.17		turbid
	1343		20	22.66	7.79	2.46		" "
	1347		30	22.64	7.58	2.13		" "
WL	1357	37.27						
	1406		40	22.63	7.47	1.810		turbid
	1416		43	22.52	7.42	1.67	661	turbid
	1419		48	22.53	7.50	1.71	448	
	1421		52	22.41	7.54	1.63	461	
WL	1431	38.04						

Total Gallons Removed 54
 Total Casing Volumes 28.5

Notes & Comments Turbidity did not improve after 8 casing volumes. Well went dry twice during surging.

WELL DEVELOPMENT RECORD

Project Name <u>NMCKC Los Angeles</u>	Well No. <u>MU405</u>
Project Number <u>6210-024-FDI-SRV</u>	Well Depth <u>36'</u>
Well Development Date <u>11/10/99</u>	Screen Interval <u>17'-32'</u>
Drilling Subcontractor <u>Spectrum Exploration</u>	Casing Diameter <u>4" Sch. 40 PVC</u>
Development Method <u>surge block</u>	Casing Vol Factor <u>0.67 gal./foot</u>
Equipment Used <u>6' bailer (2.5 gal.)</u>	Initial Water Level / Time <u>20.98</u> Water Column
Staff / Comments _____	1 Casing Volume <u>10.2</u>

Activity	Time	Depth to Water (feet TOC)	Gallons Recovered	Field Parameters				Remarks
				Temperature °C	pH	Conductivity	Other Turbidity	
Begin surging	1035							
Finish surging	1045							
Begin bailing	1046							
	1054		10	22.66	7.45	6.9		turbid
	1100		20	22.44	7.19	6.45		" "
	1106		30	22.37	7.22	5.75		" "
WL	1108	31.8				5.80mb		
	1122		40	22.39	7.37	5.80		turbid
	1140		50	22.53	7.46	5.56	995	turbid
	1145		55	22.31	7.47	5.34	1200	" "
	1151		57	22.23	7.40	5.29	1251	
WL	1156	30.35						

Total Gallons Removed 57
 Total Casing Volumes ~ 5.5

Notes & Comments Water still turbid after 4 consecutive readings within 10%. Well went dry twice during development

WELL DEVELOPMENT RECORD

Project Name NMCRG Los Angeles Well No. 11W-08
 Project Number E210-024-FDI-SKV Well Depth 36.0
 Well Development Date 1/27/2000 Screen Interval 18.5 - 33.5
 Drilling Subcontractor Spectrum Exploration Casing Diameter 4" Sch. 40 PVC
 Development Method Surge block Casing Vol Factor 0.67 gal./foot
 Equipment Used 6' bailer (2.5 gal) Initial Water Level / Time 2:05 PM 14.0 Water Column 14.0'
 Staff / Comments BB/KR 1 Casing Volume 2.0 gal/ft 2.8 gal/ft

Activity	Time	Depth to Water (feet TOC)	Gallons Recovered	Field Parameters				Remarks
				Temperature °C	pH	Conductivity	Other Turbidity	
Start pumping	0930	21.80						
Surge block	0930							2.5 min. surge
Stop pumping	0950		13.0	14.0	1.1	14.0	0.0	well dry
Check W.L.	11:03	27.30						6' to surge
Check W.L.	13:04	29.50						
Surge block	13:50	29.50	15.0					well dry after 10 min
Check W.L.	14:50	30.12						
Check W.L.	15:20	29.12						
Start bailing 3rd	15:24							
Check W.L.	15:29	34.5	~8 gal.					well dry

Total Gallons Removed 36 gallons
 Total Casing Volumes 4

Notes & Comments no discharge well
Flowmeter rate estimated to be

WELL DEVELOPMENT RECORD

Project Name NMCRC Los Angeles
Project Number 6210-024-FDI-SRV
Well Development Date 12/1/2000
Drilling Subcontractor Spectrum Exploration
Development Method surge block
Equipment Used 6' bailer (2.5 gal.)
Staff / Comments FF/pe

Well No.	142-27
Well Depth	36.1
Screen Interval	19.2 - 24.0
Casing Diameter	4" Sch. 40 PVC
Casing Vol. Factor	0.67 gal./foot
Initial Water Level / Time	22.50' / 100
1 Casing Volume	7.02 gal.

Water Column 13.5'

3 1000 37.50 6 cans 100 15.2 gallons

[illegible]

Total Gallons Removed ~37 gallons
Total Casing Volumes 4

Notes & Comments One page sent

Appendix F
Land Surveying Reports

Dulin and Boynton
Licensed Surveyors Inc
729 E. Willow Street
Signal Hill, CA 90806-2700
Phone (800) 887-6774

Dulin and Boynton

**Naval and Marine Corps Reserve Center
Los Angeles, California**

GPS Survey Report

Survey results of November 11, 1999

CDM Federal Programs Corporation

1526 Cole Boulevard, Suite 150
Golden, Colorado 80401

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GPS Control Survey Point Selection

National Geodetic Survey

Retrieval Date: July 22, 1999

Database Search

A radius search was made using the site as the central point. Criteria was limited to First Order or better points with ellipsoidal elevations. Two stations were found under 5km from the site. One was selected as our Baseline Station: N 970 RESET (EW6905).

GPS Equipment and Software

Leica's Wild System 300 dual frequency receivers and controllers. Data processed using Leica's SKI software from importation to final NAD83 California State Plane Coordinates for Zone 5.

Baseline Survey

The Station is a vertical control disk stamped "N 970 RESET 1976" set in the top of a concrete catch basin (southerly corner) located 3.9' southeast of the southeast curb of Elm Street and 38' northeast of the northeast curb of San Fernando Road. NAD 83(1994) First Order coordinate values are 34°05'15.97472"(N) and 118°13'59.18970"(W). Vertical datum is NAVD 88 First Order, Class I of 354.78'. The site vertical datum was adjusted to NGVD29 by VERTCON Ver 2.0 software. NAVD88 - NGVD29 = +0.784m (+2.57 feet).

Control Survey

With N 970 RESET established as our base line control, rapid static readings were made at four site control points (CP-1, CP-2, CP-3 and CP-4). Each point was occupied twice using different satellite configurations. After resolving ambiguities the dual readings were meaned for their final value. The coordinate values were converted from geodetic to the California State Plane Coordinate System Zone 5 (NAD83).

Notes on Scale Factors

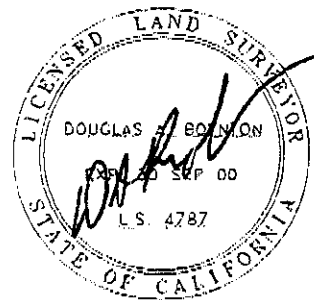
Grid scale factors were calculated from CORPSCON V5.11 and compared with the SKI results.

All coordinates are grid values at sea level.

The combined scale factor (grid and elevation) is 0.99997906

Notes on Site Control

Four site control points were established; two intervisible points were set on the upper level and two intervisible points were set on the lower level. Each point was marked with a PK nail and tin and painted CP-1, CP-2, CP-3 and CP-4. The sketch accompanying this report shows the measured values at each of these control points. Horizontal and vertical measurements were made between these points and compared to the GPS measured values. All points fit the expected accuracy of $\pm 0.01'$ for horizontal and $\pm 0.03'$ vertical. A differential level circuit was made from CP-1 through each monitor well and the loop adjustment was less than $0.01'$.



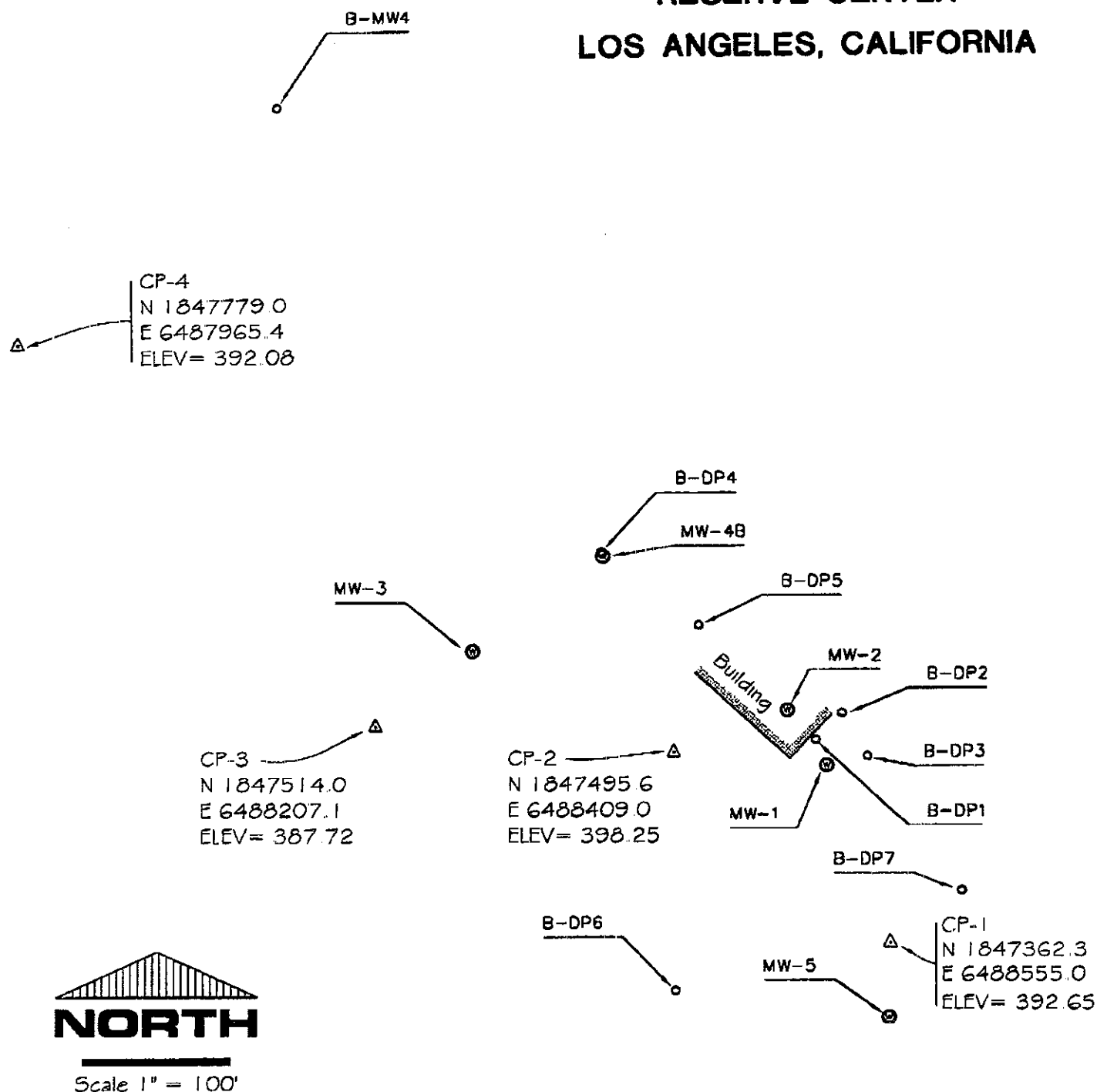
NMCRC, LOS ANGELES

CDM
FEDERAL PROGRAMS CORPORATION

NOVEMBER 18, 1999

<u>WELL</u>	<u>NORTH</u>	<u>EAST</u>	<u>ELEV</u>	<u>DESCRIPTION</u>
MW-1	1847486.5	6488512.1	397.60	4" PVC (N)
MW-1			397.95	RIM
MW-1			397.93	ASPHALT
MW-2	1847525.1	6488485.5	399.20	4" PVC (N)
MW-2			399.52	RIM
MW-2			399.48	CONCRETE
MW-3	1847566.3	6488272.6	400.71	4" PVC (N)
MW-3			401.51	RIM
MW-3			401.48	ASPHALT
MW-4B	1847632.1	6488360.4	402.28	4" PVC (N)
MW-4B			402.59	RIM
MW-4B			402.57	ASPHALT
MW-5	1847309.5	6488554.1	391.52	4" PVC (N)
MW-5			391.94	RIM
MW-5			391.87	ASPHALT

<u>BORE</u>	<u>NORTH</u>	<u>EAST</u>	<u>ELEV</u>
B-DP1	1847504.4	6488504.8	398.1
B-DP2	1847523.0	6488522.4	398.4
B-DP3	1847493.0	6488539.4	397.2
B-DP4	1847634.7	6488359.6	402.7
B-DP5	1847584.0	6488425.6	400.3
B-DP6	1847328.6	6488410.5	381.7
B-DP7	1847398.3	6488602.9	393.0
B-MW4	1847944.0	6488140.5	404.2

CDM**NAVAL AND MARINE CORPS
RESERVE CENTER
LOS ANGELES, CALIFORNIA**

Date of Survey 11 NOV 99

**DULIN & BOYNTON
LICENSED SURVEYORS**

**CDM
FEDERAL PROGRAMS CORPORATION**

<u>WELL</u>	<u>ELEV</u>	<u>DESC</u>	<u>NORTH</u>	<u>EAST</u>
MW-6	389.52	4" PVC (N)	1847297.6	6488607.2
MW-6	389.95	RIM		
MW-6	389.84	ASPHALT		
MW-7	393.10	4" PVC (N)	1847392.3	6488552.9
MW-7	393.49	RIM		
MW-7	393.44	ASPHALT		

<u>BORE</u>	<u>ELEV</u>	<u>DESC</u>	<u>NORTH</u>	<u>EAST</u>
DP-8	398.04	2" PVC (N)	1847435.9	6488485.3
DP-8	396.14	ASPHALT		
DP-9	397.08	2" PVC (N)	1847446.5	6488557.6
DP-9	395.09	ASPHALT		
DP-10	400.53	2" PVC (N)	1847538.4	6488472.0
DP-10	399.47	CONCRETE		
DP-11	400.59	2" PVC (N)	1847511.8	6488473.2
DP-11	399.48	CONCRETE		

BENCHMARK:

BM EW6905 N 970 RESET 1976
AT THE INTERSECTION OF ELM ST
AND SAN FERNANDO RD. NEAR THE SW
CORNER OF A CONCRETE CATCH BASIN,
67.3' NE OF THE ROAD CENTERLINE, SE
OF THE STREET CENTER, 23.3' NE OF A
FIREHYDRANT AND 0.7' ABOVE THE LEVEL
OF THE STREET.

NAVD88 ELEV= 354.78 FEET

Appendix G
Screening Criteria

DEPARTMENT OF HEALTH SERVICES

BERKELEY WAY
BERKELEY, CA 94704-1011

April 28, 1997



To All Concerned

Summary of California Drinking Water Standards

This is the most current summary of primary and secondary Maximum Contaminant Levels (MCL's) and State Action Levels (AL's) for California drinking water. Also listed are the unregulated chemicals for which utilities are required to periodically monitor. There have been four changes since the last update in November 1994: the addition of the regulatory action levels for lead and copper to the inorganics list; the addition of MTBE to the list of unregulated chemicals, and the deletion of diazinon as an unregulated chemical (still listed with its State AL, however), and the deletion of strychnine and its AL.

MCL's are enforceable primary drinking water standards, adopted into regulation under the Safe Drinking Water Act, which must be met by all public drinking water systems to which they apply. They are risk-management numbers based on comprehensive risk assessments, exposure levels, analytical detection limits, feasibility of removal and removal costs. In cases where no MCL has been established, State AL's serve as non-enforceable health-based guidance levels; they have not been adopted into regulation. The Department uses State AL's as interim guidance for "safe" levels of contaminants in drinking water. The lead and copper action levels differ from these health-based guidance levels because they were adopted into regulation with monitoring requirements and trigger activities by the water system if exceeded.

If you have questions, please call me at (510) 540-2177.

A handwritten signature in black ink that reads "Alexis M. Milea".

Alexis M. Milea, P.E., Chief
Standards and Technology Unit
Division of Drinking Water and
Environmental Management

RECEIVED

MAY 9 1997

CA DEPT. OF HEALTH SVCS
OFFICE OF...

Enclosure

SUMMARY

MAXIMUM CONTAMINANT LEVEL (MCL) AND ACTION LEVELS (AL) (All values in milligrams per liter (mg/L) unless otherwise noted)

<u>Constituent</u>	<u>MCL</u>	<u>AL</u>
<u>Inorganic Chemicals</u>		
Aluminum	1	
Antimony	0.006	
Arsenic	0.05	
Asbestos	7 MFL ¹	
Barium	1	
Boron		1
Beryllium	0.004	
Cadmium	0.005	
Chromium	0.05	
Copper (Level to be met at customer tap)		1.3 ²
Cyanide	0.2	
Lead (Level to be met at customer tap)		0.015 ²
Mercury	0.002	
Nickel	0.1	
Nitrate (as NO ₃)	45	
Nitrate + Nitrite (sum as nitrogen)	10	
Nitrite (as nitrogen)	1	
Selenium	0.05	
Thallium	0.002	
<u>Fluoride</u>		
<53.7 Degrees Fahrenheit	2.4	
53.8 to 58.3	2.2	
58.4 to 63.8	2.0	
63.9 to 70.6	1.8	
70.7 to 79.2	1.6	
79.3 to 90.5	1.4	
<u>Radioactivity</u>		
Gross Alpha particle activity ³	15 (pCi/l) ⁴	
Gross Beta particle activity	50 (pCi/l)	
Combined Radium-226 and Radium-228	5 (pCi/l)	
Strontium-90	8 (pCi/l)	
Tritium	20,000 (pCi/l)	
Uranium	20 (pCi/l)	
<u>Total Trihalomethanes</u>		
(Sum of bromodichloromethane, dibromochloromethane, bromoform, and chloroform)	0.1	
<u>Organic Chemicals⁵</u>		
Alachlor (Alanex)	0.002	
Aldicarb (Temik)	Unregulated (c)	0.01
Aldicarb Sulfone	Unregulated (c)	
Aldicarb Sulfoxide	Unregulated (c)	
Aldrin	Unregulated (c)	0.00005
Atrazine (Aatrex)	0.003	
Baygon		0.090
Bentazon (Basagran)	0.018	
Benzene	0.001	
a-Benzene Hexachloride (a-BHC)		0.0007

<u>Organic Chemicals</u> ⁵	<u>MCL</u>	<u>AL</u>
b-Benzene Hexachloride (b-BHC)		0.0003
Benzo (a) pyrene	0.0002	
Bromacil (Hyvar X, Hyvar XL)	Unregulated (b)	
Bromobenzene (Monobromobenzene)	Unregulated (a)	
Bromochloromethane (Chlorobromomethane)	Unregulated (b)	
Bromodichloromethane (Dichlorobromomethane)	Unregulated (a)	
Bromoform (Tribromomethane)	Unregulated (a)	
Bromomethane (Methyl Bromide)	Unregulated (a)	
Butachlor (Butanex, Lambast, Machete)	Unregulated (c)	
n-Butylbenzene (1-Butylpropane)	Unregulated (b)	0.045
Sec-butylbenzene (2-Phenylbutane)	Unregulated (b)	
Tert-butylbenzene (2-Methyl-2-phenylpropane)	Unregulated (b)	
Caplan		0.350
Carbaryl (Sevin)	Unregulated (c)	0.060
Carbofuran (Furadan)	0.018	
Carbon Tetrachloride	0.0005	
Chlordane	0.0001	
Chlorodibromomethane (Dibromochloromethane)	Unregulated (a)	
Chloroethane (Ethyl Chloride)	Unregulated (a)	
Chloroform (Trichloromethane)	Unregulated (a)	
Chloromethane (Methyl Chloride)	Unregulated (a)	
Chloropicrin		0.050(0.037) ⁶
Chlorothalonil (Bravo)	Unregulated (b)	
2-Chlorotoluene (o-Chlorotoluene)	Unregulated (a)	0.045
4-Chlorotoluene (p-chlorotoluene)	Unregulated (a)	0.045
2,4-D	0.07	
Dalapon	0.2	
Diazinon (Basudin, Neocidol)		0.014
Dibromochloromethane (Chlorodibromomethane)	Unregulated (a)	
1,2-dibromo-3-chloropropane (DBCP)	0.0002	
Dibromomethane (Methylene Bromide)	Unregulated (a)	
Dicamba (Banax, Banvel, Dianat)	Unregulated (c)	
1,2-Dichlorobenzene (o-Dichlorobenzene)	0.6	0.130(0.010) ⁷
1,3-Dichlorobenzene (m-Dichlorobenzene)	Unregulated (a)	0.130(0.020) ⁷
1,4-dichlorobenzene (p-DCB)	0.005	
Dichlorodifluoromethane (Difluorodichloromethane)	Unregulated (a)	1.0
1,1-Dichloroethane (1,1-DCA)	0.005	
1,2-dichloroethane (1,2-DCA)	0.0005	
1,1-Dichloroethylene (1,1-DCE)	0.006	
cis-1,2-Dichloroethylene	0.006	
trans-1,2-Dichloroethylene	0.01	
Dichloromethane (Methylene Chloride)	0.005	
1,2-Dichloropropane (Propylene dichloride)	0.005	
1,3-Dichloropropane	Unregulated (a)	
2,2-Dichloropropane	Unregulated (a)	
1,1-Dichloropropene	Unregulated (a)	
1,3-Dichloropropene	0.0005	
Dieldrin	Unregulated (c)	0.00005
Di(2-ethylhexyl)adipate	0.4	
Di(2-ethylhexyl)phthalate (DEPH)	0.004	
Dimethoate (Cygon)	Unregulated (b)	0.140
2,4-Dimethylphenol		0.40
Dinoseb	0.007	
Diphenamide		0.040
Diquat	0.02	
Diuron (Karmex, Krovar)	Unregulated (b)	
Endrin	0.002	

Endothall	0.1	
<u>Organic Chemicals⁵</u>	<u>MCL</u>	<u>AL</u>
Ethion		0.035
Ethylbenzene (Phenylethane)	0.7	
Ethylene Dibromide (EDB)	0.00005	
Formaldehyde		0.030
Glyphosate	0.7	
Heptachlor	0.00001	
Heptachlor Epoxide	0.00001	
Hexachlorobenzene	0.001	
Hexachlorobutadiene (Perchlorobutadiene)	Unregulated (b)	
Hexachlorocyclopentadiene	0.05	
3-Hydroxycarbofuran	Unregulated (c)	
Isopropyl N (3-Chlorophenyl) Carbamate (CIPC)		0.350
Isopropylbenzene (Cumene)	Unregulated (b)	
p-Isopropyltoluene (p-Cymene)	Unregulated (b)	
Lindane (gamma-BHC)	0.0002	
Malathion		0.160
Methoxychlor	0.04	
Methoxychlor (Lannate)	Unregulated (c)	
Methyl Isobutyl Ketone (MIBK)		0.040
Methyl Parathion		0.030
Methyl-tert-butyl ether (MTBE)	Unregulated (b)	0.035
Metolachlor (Metilachlor)	Unregulated (c)	
Metribuzin (Lexone, Sencor, Sencoral)	Unregulated (c)	
Molinate (Ordam)	0.02	
Monochlorobenzene (Chlorobenzene)	0.07	
Naphthalene (Naphthalin)	Unregulated (b)	
Oxamyl	0.2	
Parathion		0.030
Pentachloronitrobenzene (Terrachlor)		0.0009
Pentachlorophenol	0.001	
Phenol		0.0050 ⁸
1-Phenylpropane (n-Propylbenzene)	Unregulated (b)	
Picloram	0.5	
Polychlorinated Biphenyls	0.0005	
Prometryn (Caparol)	Unregulated (b)	
Propachlor (Albrass, Ramrod)	Unregulated (c)	
Simazine (Princep)	0.004	
Styrene (Vinylbenzene)	0.1	
2,4,5-TP (Silvex)	0.05	
2,3,7,8-TCDD (Dioxin)	0.00000003	
1,1,2,2-Tetrachloroethane	0.001	
1,1,1,2-Tetrachloroethane	Unregulated (a)	
Tetrachloroethylene (PCE)	0.005	
Thiebencarb (Bolero) ⁹	0.07	
Toluene (Methylbenzene)	0.15	
Toxaphene	0.003	
1,2,3-Trichlorobenzene (vic-Trichlorobenzene)	Unregulated (b)	
1,2,4-Trichlorobenzene (Unsym-Trichlorobenzene)	0.07	
1,1,1-Trichloroethane (1,1,1-TCA)	0.200	

Organic Chemicals⁶

	<u>MCL</u>	<u>AL</u>
1,1,2-Trichloroethane (1,1,2-TCA)	0.005	
Trichloroethylene (TCE)	0.005	
Trichlorofluoromethane (Freon 11)	0.15	
1,2,3-Trichloropropane (Allyl Trichloride)	Unregulated (a)	
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	1.2	
1,2,4-Trimethylbenzene (Pseudocumene)	Unregulated (b)	
1,3,5-Trimethylbenzene (Mesitylene)	Unregulated (b)	
Trithion		0.0070
Vinyl Chloride (VC)	0.0005	
Xylenes (single isomer or sum of isomers)	1.750	

Secondary MCL's

Aluminum	0.2
Chloride	250-500-600 ¹⁰
Color	1.0
Corrosivity	Non-corrosive
Foaming agents (MBAS)	0.5
Iron	0.3
Manganese	0.05
Odor-Threshold	3 units
PH	6.5 - 8.5
Silver	0.1
Specific Conductance (micromhos)	900 - 1600 - 2200 ¹⁰
Sulfate	250 - 500 - 600
Thiobencarb (Bolero) ¹¹	0.001
Total Dissolved Solids	500 - 1000 - 1500 ¹⁰
Turbidity	5 units
Zinc	5.0

Footnotes

- 1 MFL = million fibers per liter, MCL is for fibers exceeding 10 um in length.
- 2 The lead and copper action levels differ from the Health Services guidance action levels. They are regulatory levels which trigger corrosion control treatment studies and other activities.
- 3 Including Radium-226 but excluding Radon and Uranium.
- 4 pCi/l = pico Curies per liter.
- 5 Unregulated (a): monitoring required.
Unregulated (b) and (c): monitor if determined vulnerable.
- 6 Taste and odor threshold.
- 7 Taste and odor threshold-action level is either for a single isomer or for the sum of the 2 isomers.
- 8 Taste and odor threshold for chlorinated systems.
- 9 Also listed with a Secondary MCL of 0.001 mg/l.
- 10 Range listed includes: the recommended level - the upper level acceptable - the level acceptable only on a short term basis.
- 11 Also listed with a Primary MCL of 0.07 mg/l.

```

key:  !=IRIS  n=NCEA  h=HFAST  x=WITHDRAWN  o=Other  EPA DOCUMENTS  !=ROUTE  EXTRAPOLATION  ca=CANCER  PRG  nc=NONCANCER  PRG  sat=SOIL SATURATION  max=CEILING LIMIT  *(where:  nc < 100X  ca)  ***(where:  nc < 10X  ca)

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[illegible]

Key: I=IRIS n=NCEA h=HEAST x=WITHDRAWN o=Other EPA DOCUMENTS r=ROUTE EXTRAPOLATION ca=CANCER PRG nc=NONCANCER PRG sal=SOIL SATURATION max=CEILING LIMIT * (where: nc < 100X ca) ** (where: nc < 10X ca)

FOR PLANNING PURPOSES

TOXICITY INFORMATION

CONTAMINANT

PRELIMINARY REMEDIATION GOALS (PRGs)

SOIL SCREENING LEVELS

SFO 1/(mg/kg-d)	RfDo (mg/kg-d)	SF 1/(mg/kg-d)	RID (mg/kg-d)	V skin O abs. C soils	CAS No.	Residential Soil (mg/kg)	Industrial Soil (mg/kg)	Ambient Air (ug/m ³)	Tap Water (mg/l)	Migration to Ground Water DAF 20 (mg/kg)	DAF 1 (mg/kg)
						3.7E-02	1.9E-01	5.2E-04	5.2E-03		
1.3E+01	3.0E-01	1.3E+01	3.0E-01	0 0 10	99-07-7	1.8E+04	1.9E-01	5.2E-04	5.2E-03	ca	
1.7E-01	2.0E-03	1.7E-01	2.0E-03	0 0 10	100-51-6	8.9E-01	2.3E+00	max	1.1E+03	nc	1.1E+04
2.0E-03	2.0E-03	8.4E+00	5.7E-06	0 0 10	100-44-7	8.9E-01	2.3E+00	ca	4.0E-02	ca	6.6E-02
1.0E-04	1.0E-04	1.0E-04	1.0E-04	0 0 10	7440-41-7	1.5E+02	2.2E+03	ca**	8.0E-04	ca*	7.3E+01
1.5E-02	1.5E-02	1.5E-02	1.5E-02	0 0 10	141-66-2	6.1E+00	8.8E+01	nc	3.7E-01	nc	3.6E+00
5.0E-02	5.0E-02	5.0E-02	5.0E-02	0 0 10	8957-04-3	3.5E+02	3.5E+02	sal	1.8E+02	nc	3.0E+02
1.1E+00	4.0E-02	1.2E+00	4.0E-02	0 0 10	92-32-4	2.1E-01	6.2E-01	ca	5.8E-03	ca	9.8E-03
7.0E-02	4.0E-02	3.5E-02	4.0E-02	0 0 10	108-60-1	2.9E+00	8.1E+00	ca	1.9E-01	ca	2.7E-01
2.2E+02	2.2E+02	2.2E+02	2.2E+02	0 0 10	542-88-1	1.9E-04	4.4E-04	ca	3.1E-05	ca	5.2E-05
7.0E-02	2.0E-02	3.5E-02	2.2E-02	0 0 10	108-60-1	6.9E+00	3.5E+01	ca	1.9E-01	ca	9.8E-01
1.4E-02	5.0E-02	1.4E-02	5.0E-02	0 0 10	117-81-7	3.5E+01	1.8E+02	ca	4.8E-01	ca	4.8E+00
9.0E-02	9.0E-02	9.0E-02	9.0E-02	0 0 10	80-05-7	3.1E+03	4.4E+04	nc	1.8E+02	nc	1.8E+03
2.0E-02	2.0E-02	2.0E-02	2.0E-02	0 0 10	7440-42-8	5.5E+03	7.9E+04	nc	2.1E+01	nc	3.3E+03
6.2E-02	2.0E-02	6.2E-02	2.0E-02	0 0 10	7637-07-2	2.8E+01	9.2E+01	nc	7.3E-01	nc	2.0E+01
7.9E-03	1.4E-03	3.5E-03	2.0E-02	0 0 10	108-96-1	1.0E+00	2.4E+00	ca	1.1E-01	ca	1.8E-01
1.4E-03	1.4E-03	1.4E-03	1.4E-03	0 0 10	75-27-4	6.2E+01	3.1E+02	ca*	1.7E+00	ca*	8.5E+00
5.0E-03	5.0E-03	5.0E-03	5.0E-03	0 0 10	75-25-2	3.9E+00	1.3E+01	nc	5.2E+00	nc	8.7E+00
2.0E-02	2.0E-02	2.0E-02	2.0E-02	0 0 10	74-83-9	3.1E+02	4.4E+03	nc	1.8E-01	nc	1.8E+02
1.0E-01	1.0E-01	1.0E-01	1.0E-01	0 0 10	101-55-3	1.2E+03	1.8E+04	nc	7.3E+01	nc	7.3E+02
5.0E-02	5.0E-02	5.0E-02	5.0E-02	0 0 10	2104-99-3	1.2E+03	1.8E+04	nc	7.3E+01	nc	7.3E+02
2.0E-02	2.0E-02	2.0E-02	2.0E-02	0 0 10	1689-84-5	3.5E-03	7.6E-03	ca	3.7E-03	ca	6.2E-03
1.8E+00	1.8E+00	1.8E+00	1.8E+00	0 0 10	106-99-0	6.1E+03	8.8E+04	nc	3.7E+02	nc	3.6E+03
1.0E-01	1.0E-01	1.0E-01	1.0E-01	0 0 10	71-36-3	3.1E+03	4.4E+04	nc	1.8E+02	nc	1.8E+03
5.0E-02	5.0E-02	5.0E-02	5.0E-02	0 0 10	2008-41-5	1.4E+02	2.4E+02	sal	3.7E+01	nc	6.1E+01
1.0E-02	1.0E-02	1.0E-02	1.0E-02	0 0 10	104-51-8	1.1E+02	2.2E+02	sal	3.7E+01	nc	6.1E+01
1.0E-02	1.0E-02	1.0E-02	1.0E-02	0 0 10	135-9-88	1.3E+02	3.9E+02	sal	3.7E+01	nc	6.1E+01
2.0E-01	2.0E-01	2.0E-01	2.0E-01	0 0 10	85-66-7	1.2E+04	1.0E+05	max	7.3E+02	nc	7.3E+03
1.0E+00	1.0E+00	1.0E+00	1.0E+00	0 0 10	85-70-1	6.1E+04	1.0E+05	max	3.7E+03	nc	3.6E+04
3.0E-03	3.0E-03	3.0E-03	3.0E-03	0 0 10	75-60-5	1.8E+02	2.6E+03	nc	1.1E+01	nc	1.1E+02
5.0E-04	5.0E-04	5.0E-04	5.0E-04	0 0 001	7440-43-9	3.7E+01	8.1E+02	nc	1.1E-03	ca	1.8E+01
5.0E-01	5.0E-01	5.0E-01	5.0E-01	0 0 10	105-90-2	9.0E+00	1.0E+05	1.8E+03	1.8E+04	nc	
8.6E-03	8.6E-03	8.6E-03	8.6E-03	0 0 10	2425-06-1	5.7E+01	2.9E+02	ca**	7.8E-01	ca**	7.8E+00
3.5E-03	3.5E-03	3.5E-03	3.5E-03	0 0 10	133-06-2	1.4E+02	7.0E+02	ca*	1.9E+00	ca*	1.9E+01
2.0E-02	2.0E-02	2.0E-02	2.0E-02	0 0 10	63-25-2	6.1E+03	8.8E+04	nc	4.0E+02	nc	3.6E+03
1.0E-01	1.0E-01	1.0E-01	1.0E-01	0 0 10	86-74-8	2.4E+01	1.2E+02	ca	3.4E-01	ca	3.4E+00
5.0E-03	5.0E-03	5.0E-03	5.0E-03	0 0 10	1553-66-2	3.1E+02	4.4E+03	nc	1.8E+01	nc	1.8E+02
1.0E-01	1.0E-01	1.0E-01	1.0E-01	0 0 10	75-15-0	3.6E+02	7.2E+02	sal	7.3E+02	nc	1.0E+03
1.3E-01	7.0E-04	5.3E-02	7.0E-04	0 0 10	58-23-5	2.4E-01	5.3E-01	ca*	1.3E-01	ca*	1.7E-01
1.0E-02	1.0E-02	1.0E-02	1.0E-02	0 0 10	55205-14-9	6.1E+02	8.8E+03	nc	3.7E+01	nc	3.6E+02
2.0E-03	2.0E-03	2.0E-03	2.0E-03	0 0 10	5234-68-4	1.0E-01	1.0E-01	nc	7.3E+00	nc	7.3E+01
1.5E-02	1.5E-02	1.5E-02	1.5E-02	0 0 10	302-17-0	9.2E+02	1.3E+04	nc	5.5E+01	nc	5.5E+02
4.0E-01	4.0E-01	4.0E-01	4.0E-01	0 0 10	118-75-2	1.2E+00	6.1E+00	ca	1.7E-02	ca	1.7E-01
3.5E-01	5.0E-04	3.5E-01	5.0E-04	0 0 04	12789-03-6	1.6E+00	1.1E+01	ca*	1.9E-02	ca*	1.9E-01
2.0E-02	2.0E-02	2.0E-02	2.0E-02	0 0 10	90982-32-4	1.2E+03	1.8E+04	nc	7.3E+01	nc	7.3E+02
1.0E-01	1.0E-01	1.0E-01	1.0E-01	0 0 10	7782-50-5			2.1E-01	2.1E+01	nc	3.6E+03
2.0E-03	2.0E-03	2.0E-03	2.0E-03	0 0 10	75-11-8	1.2E+02	1.8E+03	nc	7.3E+00	nc	7.3E+01
8.6E-06	8.6E-06	8.6E-06	8.6E-06	0 0 10	532-27-4	3.3E-02	1.1E-01	nc	3.1E-02	nc	5.2E-02
4.0E-03	4.0E-03	4.0E-03	4.0E-03	0 0 10	106-47-8	2.4E+02	3.5E+03	nc	1.5E+01	nc	1.5E+02
2.0E-02	2.0E-02	2.0E-02	2.0E-02	0 0 10	108-90-7	1.5E+02	5.4E+02	nc	6.2E+01	nc	1.1E+02

Key: L=LRIS R=NCEA h=HEAST x=WITHDRAWN o=Other EPA DOCUMENTS f=ROUTE EXTRAPOLATION ca=CANCER PRG nc=NONCANCER PRG sat=SOIL SATURATION max=CEILING LIMIT (where: nc < 100X ca) ** (where: nc < 10X ca)

FOR PLANNING PURPOSES

TOXICITY INFORMATION

CONTAMINANT

PRELIMINARY REMEDIATION GOALS (PRGs)

SOIL SCREENING LEVELS

SFO 1/(mg/kg-d)	RDO (mg/kg-d)	SFI 1/(mg/kg-d)	RIQ (mg/kg-d)	V. SOR O. ads C. soils	CAS No.	Residential Soil (mg/kg)	Industrial Soil (mg/kg)	Ambient Air (ug/m ³)	Tap Water (ug/l)	Migration to Ground Water DAF 20 (mg/kg)	DAF 1 (mg/kg)
2.7E-01 h	2.0E-01 h	2.7E-01 h	2.0E-01 h	0	0.10	510-15-6	1.8E+00 ca	9.1E+00 ca	2.5E-02 ca	2.5E-01 ca	nc
2.0E-02 h	2.0E-02 h	2.0E-02 h	2.0E-02 h	0	0.10	74-11-3	1.2E+04 nc	1.0E+05 max	7.3E+02 nc	7.3E+03 nc	nc
2.0E-02 h	2.0E-02 h	2.0E-02 h	2.0E-02 h	0	0.10	98-56-6	1.2E+03 nc	1.8E+04 nc	7.3E+01 nc	7.3E+02 nc	nc
2.0E-01 h	2.0E-01 h	2.0E-01 h	2.0E-01 h	0	0.10	126-98-8	3.6E+00 nc	1.2E+01 nc	7.3E+00 nc	1.4E+01 nc	nc
4.0E-01 h	4.0E-01 h	4.0E-01 h	4.0E-01 h	0	0.10	109-68-3	4.8E+02 sat	4.8E+02 sat	1.5E+03 nc	2.4E+03 nc	nc
1.4E+01 i	1.4E+01 i	1.4E+01 i	1.4E+01 i	0	0.10	75-68-3	3.4E+02 sat	3.4E+02 sat	5.2E+04 nc	8.7E+04 nc	nc
1.4E+01 i	1.4E+01 i	1.4E+01 i	1.4E+01 i	0	0.10	75-45-6	3.4E+02 sat	3.4E+02 sat	5.1E+04 nc	8.5E+04 nc	nc
2.9E-03 n	4.0E-01 n	2.8E-03 n	2.9E-03 n	0	0.10	75-90-3	3.0E+00 ca	6.5E+00 ca	2.3E+00 ca	4.6E+00 ca	nc
6.1E-03 i	1.0E-02 i	8.1E-02 i	8.8E-05 n	0	0.10	110-75-8	2.4E-01 ca	5.2E-01 ca	8.4E-02 ca	1.6E-01 ca	6E-01
1.3E-02 h	6.3E-03 h	8.8E-02 h	8.8E-02 h	0	0.10	67-56-3	1.2E+00 ca	2.7E+00 ca	1.1E+00 ca	1.5E+00 ca	nc
5.8E-01 h	5.8E-01 h	5.8E-01 h	5.8E-01 h	0	0.10	95-69-2	8.4E-01 ca	4.3E+00 ca	1.2E-02 ca	1.2E-01 ca	nc
4.8E-01 h	4.8E-01 h	4.8E-01 h	4.8E-01 h	0	0.10	3165-93-3	1.1E+00 ca	5.4E+00 ca	1.5E-02 ca	1.5E-01 ca	nc
8.0E-02 i	8.0E-02 i	8.0E-02 i	8.0E-02 i	0	0.10	91-58-7	4.9E+03 nc	2.7E+04 nc	2.9E+02 nc	4.9E+02 nc	nc
2.5E-02 h	2.5E-02 h	2.5E-02 h	2.5E-02 h	0	0.10	88-73-3	8.1E+00 ca	2.3E+01 ca	2.7E-01 ca	4.5E-01 ca	nc
1.9E-02 h	1.9E-02 h	1.9E-02 h	1.9E-02 h	0	0.10	100-00-5	1.1E+01 ca	3.2E+01 ca	3.7E-01 ca	6.2E-01 ca	nc
1.1E-02 h	1.1E-02 h	1.1E-02 h	1.1E-02 h	0	0.10	75-29-6	6.3E+01 nc	2.4E+02 nc	1.8E+01 nc	3.0E+01 nc	4E-00
2.0E-01 i	2.0E-01 i	2.0E-01 i	2.0E-01 i	0	0.10	95-57-8	1.7E+02 nc	5.9E+02 nc	1.0E+02 nc	1.7E+02 nc	nc
3.0E-03 i	3.0E-03 i	3.0E-03 i	3.0E-03 i	0	0.10	2921-88-2	4.4E+01 ca	2.2E+02 ca	6.1E-01 ca	6.1E+00 ca	nc
1.0E-02 h	1.0E-02 h	1.0E-02 h	1.0E-02 h	0	0.10	5598-13-0	1.6E+02 nc	5.7E+02 nc	7.3E+01 nc	1.2E+02 nc	nc
5.0E-02 i	5.0E-02 i	5.0E-02 i	5.0E-02 i	0	0.10	54902-72-3	1.2E+04 nc	1.0E+05 max	7.3E+02 nc	7.3E+03 nc	nc
8.0E-04 h	8.0E-04 h	8.0E-04 h	8.0E-04 h	0	0.10	82238-56-4	1.8E+02 nc	2.6E+03 nc	1.1E+01 nc	1.1E+02 nc	nc
1.5E+00 i	1.5E+00 i	1.5E+00 i	1.5E+00 i	0	0.10	16065-83-1	6.1E+02 nc	8.8E+03 nc	3.7E-01 nc	3.6E+02 nc	nc
3.0E-03 i	2.9E-02 i	2.9E-02 i	2.9E-02 i	0	0.10	18540-29-9	3.1E+03 nc	7.6E+04 nc	3.5E-03 nc	5.9E-03 nc	nc
6.0E-02 n	2.2E+00 n	2.2E+00 n	2.2E+00 n	0	0.10	7440-48-4	2.9E+03 nc	7.6E+04 nc	3.1E-03 nc	1.4E+03 nc	nc
3.7E-02 h	3.7E-02 h	3.7E-02 h	3.7E-02 h	0	0.10	8007-45-2	5.3E-03 ca	1.1E-02 ca	3.5E-03 ca	5.9E-03 ca	nc
1.8E+00 h	1.8E+00 h	1.8E+00 h	1.8E+00 h	0	0.10	7440-50-8	1.6E+02 nc	5.2E+02 nc	4.0E+02 nc	6.6E+02 nc	nc
1.0E-01 i	1.0E-01 i	1.0E-01 i	1.0E-01 i	0	0.10	98-82-8	5.8E-01 ca	2.9E+00 ca	8.0E-03 ca	8.0E-02 ca	nc
2.0E-03 h	2.0E-03 h	2.0E-03 h	2.0E-03 h	0	0.10	21726-46-2	1.0E+05 max	1.0E+05 max	2.3E-05 ca	1.1E+02 nc	2E+00
1.0E-01 h	1.0E-01 h	1.0E-01 h	1.0E-01 h	0	0.10	542-62-1	3.0E+01 ca	6.4E+01 ca	2.3E-05 ca	1.1E+02 nc	2E+00
4.0E-02 i	4.0E-02 i	4.0E-02 i	4.0E-02 i	0	0.10	592-01-8	2.0E-01 ca	6.4E+01 ca	2.3E-05 ca	1.1E+02 nc	2E+00
5.0E-03 i	5.0E-03 i	5.0E-03 i	5.0E-03 i	0	0.10	544-62-3	4.7E+03 nc	1.0E+05 max	3.1E-03 nc	2.2E+03 nc	nc
2.0E-02 i	2.0E-02 i	2.0E-02 i	2.0E-02 i	0	0.10	57-12-5	2.9E+03 nc	7.6E+04 nc	3.1E-03 nc	1.4E+03 nc	nc
2.0E-02 i	2.0E-02 i	2.0E-02 i	2.0E-02 i	0	0.10	74-90-8	5.3E-03 ca	1.1E-02 ca	3.5E-03 ca	5.9E-03 ca	nc
5.0E-02 i	5.0E-02 i	5.0E-02 i	5.0E-02 i	0	0.10	151-50-8	1.1E+01 nc	1.8E+04 nc	3.1E+00 nc	6.2E+00 nc	4E-01
2.0E-01 i	2.0E-01 i	2.0E-01 i	2.0E-01 i	0	0.10	506-61-8	1.1E+01 nc	1.8E+04 nc	3.1E+00 nc	6.2E+00 nc	nc
1.0E-01 i	1.0E-01 i	1.0E-01 i	1.0E-01 i	0	0.10	506-64-9	3.1E+03 nc	4.4E+04 nc	1.8E+03 nc	1.8E+03 nc	nc
4.0E-02 i	4.0E-02 i	4.0E-02 i	4.0E-02 i	0	0.10	143-33-9	1.2E+04 nc	1.0E+05 max	7.3E+02 nc	7.3E+03 nc	nc
5.0E-02 i	5.0E-02 i	5.0E-02 i	5.0E-02 i	0	0.10	557-21-1	6.1E+03 nc	8.8E+04 nc	3.6E+03 nc	3.6E+03 nc	nc
4.0E-02 i	4.0E-02 i	4.0E-02 i	4.0E-02 i	0	0.10	460-19-5	2.4E+03 nc	3.5E+04 nc	1.5E+03 nc	1.5E+03 nc	nc
9.0E-02 i	9.0E-02 i	9.0E-02 i	9.0E-02 i	0	0.10	506-66-3	3.1E+03 nc	4.4E+04 nc	1.5E+02 nc	2.4E+02 nc	nc
5.0E-02 i	5.0E-02 i	5.0E-02 i	5.0E-02 i	0	0.10	506-77-4	2.9E+02 nc	9.7E+02 nc	3.3E+02 nc	5.3E+02 nc	nc
5.0E+00 i	5.0E+00 i	5.0E+00 i	5.0E+00 i	0	0.10	108-94-1	1.6E+02 nc	5.4E+02 nc	1.8E+02 nc	3.0E+02 nc	nc
2.0E-01 i	2.0E-01 i	2.0E-01 i	2.0E-01 i	0	0.10	108-94-1	1.0E+05 max	1.0E+05 max	1.8E+04 nc	1.8E+05 nc	nc
5.0E-03 i	5.0E-03 i	5.0E-03 i	5.0E-03 i	0	0.10	69095-85-8	1.2E+04 nc	1.0E+05 max	7.3E+02 nc	7.3E+03 nc	nc
1.0E-02 i	1.0E-02 i	1.0E-02 i	1.0E-02 i	0	0.10	52315-02-8	3.1E+02 nc	4.4E+03 nc	1.8E+01 nc	1.8E+02 nc	nc
7.5E-03 i	7.5E-03 i	7.5E-03 i	7.5E-03 i	0	0.10	66015-27-8	6.1E+02 nc	8.8E+03 nc	3.7E+01 nc	3.6E+02 nc	nc
1.0E-02 i	1.0E-02 i	1.0E-02 i	1.0E-02 i	0	0.10	1861-32-1	4.8E+02 nc	6.6E+03 nc	2.7E+01 nc	2.7E+02 nc	nc
3.0E-02 i	3.0E-02 i	3.0E-02 i	3.0E-02 i	0	0.10	75-99-0	1.8E+03 nc	2.6E+04 nc	1.1E+02 nc	1.1E+03 nc	nc

Key: I=IRIS; R=NCEA; H=HEAST; X=WITHDRAWN; O=Other EPA DOCUMENTS; R=ROUTE EXTRAPOLATION; C=CANCER PRG; NC=NONCANCER PRG; sat=SOIL SATURATION; max=CEILING LIMIT; * (where: nc < 100X ca); ** (where: nc < 10X ca)

FOR PLANNING PURPOSES

TOXICITY INFORMATION										PRELIMINARY REMEDIATION GOALS (PRGs)										SOIL SCREENING LEVELS						
SFO	RfDo	SFI	RfDI	V skin	O abs	C soils	CAS No	CONTAMINANT												Residential Soil (mg/kg)	Industrial Soil (mg/kg)	Ambient Air (ug/m ³)	Tap Water (ug/l)	Migration to Ground Water DAF 20 (mg/kg)	DAF 1 (mg/kg)	
1/(mg/kg-d)	(mg/kg-d)	1/(mg/kg-d)	(mg/kg-d)																							
2.4E-01	2.5E-02	2.4E-01	2.5E-02	r	0	0.10	39515-41-8	Dantrol												1.5E+03	2.2E+04	nc	9.1E+01	nc	9.1E+02	nc
3.4E-01	2.4E-01	3.4E-01	2.4E-01	r	0	0.03	72-54-8	DDD												2.4E+00	1.7E+01	ca	2.8E-02	ca	2.8E-01	ca
3.4E-01	3.4E-01	3.4E-01	3.4E-01	r	0	0.03	72-55-9	DDE												1.7E+00	1.2E+01	ca	2.0E-02	ca	2.0E-01	ca
3.4E-01	5.0E-04	3.4E-01	5.0E-04	r	0	0.03	50-29-3	DDT												1.7E+00	1.2E+01	ca	2.0E-02	ca	2.0E-01	ca
1.0E-02	1.0E-02	1.0E-02	1.0E-02	r	0	0.10	1163-19-5	Decabromodiphenyl ether												6.1E+02	8.8E+03	nc	3.7E+01	nc	3.6E+02	nc
4.0E-05	4.0E-05	4.0E-05	4.0E-05	r	0	0.10	6055-46-3	Dermeton												2.4E+00	3.5E+01	nc	1.5E-01	nc	1.5E+00	nc
6.1E-02	6.1E-02	6.1E-02	6.1E-02	r	0	0.10	2303-16-4	Diallate												8.0E+00	4.0E+01	ca	1.1E-01	ca	1.1E+00	ca
9.0E-04	9.0E-04	9.0E-04	9.0E-04	r	0	0.10	333-41-5	Diazinon												5.5E+01	7.9E+02	nc	3.3E+00	nc	3.3E+01	nc
4.0E-03	4.0E-03	4.0E-03	4.0E-03	r	0	0.10	132-64-9	Dibenzofuran												2.9E+02	5.1E+03	nc	2.4E+01	nc	2.4E+02	nc
1.0E-02	1.0E-02	1.0E-02	1.0E-02	r	0	0.10	106-37-6	1,4-Dibromobenzene												6.1E+02	8.8E+03	nc	3.7E+01	nc	3.6E+02	nc
8.4E-02	8.4E-02	8.4E-02	8.4E-02	r	0	0.10	124-48-1	1,4-Dibromochloromethane												1.1E+00	2.7E+00	ca	8.0E-02	ca	1.3E-01	ca
1.4E+00	5.7E-05	2.4E-03	5.7E-05	r	0	0.10	98-12-8	1,2-Dibromo-3-chloropropane												4.5E-01	4.0E+00	ca	2.1E-01	ca	4.8E-02	ca
8.5E+01	5.7E-05	7.7E-01	5.7E-05	r	0	0.10	106-93-4	"CAL-Modified PRG" (PEA, 1994)												6.0E-02	9.6E-04	ca	9.6E-04	ca	4.7E-03	ca
1.0E-01	1.0E-01	1.0E-01	1.0E-01	r	0	0.10	84-74-2	1,2-Dibromomethane												6.1E+03	8.8E+04	ca	3.7E+02	ca	7.6E-04	ca
3.0E-02	3.0E-02	3.0E-02	3.0E-02	r	0	0.10	1916-00-9	Dibutyl phthalate												1.8E+03	2.6E+04	nc	1.1E+02	nc	1.1E+03	nc
9.0E-02	9.0E-02	9.0E-02	9.0E-02	r	0	0.10	96-50-1	Dicamba												3.7E+02	3.7E+02	sal	2.1E+02	nc	3.7E+02	nc
9.0E-04	9.0E-04	9.0E-04	9.0E-04	r	0	0.10	541-73-1	1,2-Dichlorobenzene												1.3E+01	5.2E+01	nc	3.3E+00	nc	5.5E+00	nc
2.4E-02	3.0E-02	2.2E-02	3.0E-02	r	0	0.10	106-46-7	1,3-Dichlorobenzene												3.4E+00	8.1E+00	ca	3.1E-01	ca	5.0E-01	ca
4.5E-01	4.5E-01	4.5E-01	4.5E-01	r	0	0.10	91-94-1	3,3-Dichlorobenzidine												1.1E+00	5.5E+00	ca	1.5E-02	ca	1.5E-01	ca
9.3E+00	9.3E+00	9.3E+00	9.3E+00	r	0	0.10	764-41-0	1,4-Dichloro-2-butene												7.9E+03	1.8E-02	ca	7.2E-04	ca	1.2E-03	ca
2.0E-01	2.0E-01	2.0E-01	2.0E-01	r	0	0.10	75-71-8	Dichlorodifluoromethane												9.4E+01	3.1E+02	nc	2.1E+02	nc	3.9E+02	nc
9.1E-02	3.0E-02	9.1E-02	3.0E-02	r	0	0.10	75-34-3	1,1-Dichloroethane												5.9E+02	2.1E+03	nc	5.2E+02	nc	8.1E+02	nc
6.0E-01	9.0E-03	1.8E-01	9.0E-03	r	0	0.10	107-06-2	1,2-Dichloroethane (EDC)												3.5E-01	7.6E-01	ca	7.4E-02	ca	1.2E-01	ca
1.0E-02	1.0E-02	1.0E-02	1.0E-02	r	0	0.10	75-35-4	1,1-Dichloroethylene												5.4E-02	1.2E-01	ca	3.8E-02	ca	4.6E-02	ca
2.0E-02	2.0E-02	2.0E-02	2.0E-02	r	0	0.10	156-59-2	1,2-Dichloroethylene (cis)												4.3E+01	1.5E+02	nc	3.7E+01	nc	6.1E+01	nc
3.0E-03	3.0E-03	3.0E-03	3.0E-03	r	0	0.10	156-60-5	1,2-Dichloroethylene (trans)												6.3E+01	2.1E+02	nc	7.3E+01	nc	1.2E+02	nc
8.0E-02	8.0E-02	8.0E-02	8.0E-02	r	0	0.10	120-83-2	2,4-Dichlorophenol												1.8E+02	2.6E+03	nc	1.1E+01	nc	1.1E+02	nc
1.0E-02	1.0E-02	1.0E-02	1.0E-02	r	0	0.05	94-75-7	4-(2,4-Dichlorophenoxy)butyric Acid (2,4-DB)												4.9E+02	7.0E+03	nc	2.9E+01	nc	2.9E+02	nc
6.0E-02	6.0E-02	6.0E-02	6.0E-02	r	0	0.10	78-87-5	2,4-Dichlorophenoxyacetic Acid (2,4-D)												6.9E+02	1.2E+04	nc	3.7E+01	nc	3.6E+02	nc
1.9E-01	3.0E-04	1.3E-01	3.0E-04	r	0	0.10	618-23-9	1,2-Dichloropropane												8.2E-02	1.8E-01	ca	5.2E-02	ca	8.1E-02	ca
2.9E-01	5.0E-04	2.9E-01	5.0E-04	r	0	0.10	62-73-7	1,3-Dichloropropane												1.8E+02	2.6E+03	nc	1.1E+01	nc	1.1E+02	nc
4.4E-01	4.4E-01	4.4E-01	4.4E-01	r	0	0.10	77-73-6	Dichlorvos												3.5E-01	7.7E-01	ca	9.9E-02	ca	1.6E-01	ca
1.9E+01	5.0E-05	1.9E+01	5.0E-05	r	0	0.10	60-57-1	Dicolol												8.2E-02	1.8E-01	ca	5.2E-02	ca	8.1E-02	ca
5.7E-03	5.7E-03	5.7E-03	5.7E-03	r	0	0.10	112-34-5	Diethyl glycol, monobutyl ether												1.8E+02	2.6E+03	nc	1.1E+01	nc	1.1E+02	nc
2.0E+00	2.0E+00	2.0E+00	2.0E+00	r	0	0.10	111-90-0	Diethylene glycol, monoethyl ether												1.7E+00	8.5E+00	ca	2.3E-02	ca	2.3E-01	ca
1.1E-02	1.1E-02	1.1E-02	1.1E-02	r	0	0.10	617-84-5	Diethylformamide												1.1E+00	5.6E+00	ca	1.5E-02	ca	1.5E-01	ca
1.2E-03	6.0E-01	1.2E-03	6.0E-01	r	0	0.10	103-23-1	Di(2-ethylhexyl)adipate												5.4E-01	1.8E+00	nc	2.1E-01	nc	4.2E-01	nc
4.7E+03	4.7E+03	4.7E+03	4.7E+03	r	0	0.10	56-53-1	Diethylstilbestrol												3.0E-02	1.5E-01	ca	4.2E-03	ca	4.2E-03	ca
8.0E-02	8.0E-02	8.0E-02	8.0E-02	r	0	0.10	43222-46-8	Difenzoquat (Avenge)												3.5E+02	5.0E+03	nc	2.1E+01	nc	2.1E+02	nc
2.0E-02	2.0E-02	2.0E-02	2.0E-02	r	0	0.10	35387-38-5	Diisobutyl alcohol												1.0E+05	1.0E+05	max	7.3E+03	nc	7.3E+04	nc
1.1E-01	1.1E-01	1.1E-01	1.1E-01	r	0	0.10	75-37-6	Diisopropyl methylphosphonate												6.7E+02	9.7E+03	nc	4.0E+01	nc	4.0E+02	nc
8.0E-02	8.0E-02	8.0E-02	8.0E-02	r	0	0.10	1446-75-6	Dimethipin												4.1E+02	2.1E+03	nc	5.6E+00	nc	5.6E+01	nc
2.0E-02	2.0E-02	2.0E-02	2.0E-02	r	0	0.10	5290-64-7	Dimethoate												4.9E+04	1.0E+05	max	2.9E+03	nc	2.9E+04	nc
2.0E-04	2.0E-04	2.0E-04	2.0E-04	r	0	0.10	50-51-5	3,3'-Dimethoxybenzidine												1.0E-04	5.2E-04	ca	1.4E-06	ca	1.4E-05	ca
1.4E-02	1.4E-02	1.4E-02	1.4E-02	r	0	0.10	119-90-4	Dimethylamine												4.9E+03	7.0E+04	nc	2.9E+02	nc	2.9E+03	nc
5.7E-08	5.7E-08	5.7E-08	5.7E-08	r	0	0.10	124-40-3	Di-N-Dimethylaniline												1.2E+02	1.8E+03	nc	7.3E+00	nc	7.3E+01	nc
2.0E-03	2.0E-03	2.0E-03	2.0E-03	r	0	0.10	121-69-7	2,4-Dimethylaniline												6.5E-01	3.3E+00	ca	9.0E-03	ca	9.0E-02	ca
7.5E-01	7.5E-01	7.5E-01	7.5E-01	r	0	0.10	95-58-1	2,4-Dimethylaniline hydrochloride												8.4E-01	4.3E+00	ca	1.2E-02	ca	1.2E-01	ca
5.8E-01	5.8E-01	5.8E-01	5.8E-01	r	0	0.10	21436-96-4	1,1-Dimethylhydrazine												5.3E-02	2.7E-01	ca	7.3E-04	ca	7.3E-03	ca
9.2E+00	9.2E+00	9.2E+00	9.2E+00	r	0	0.10	119-93-7	1,1-Dimethylhydrazine												1.9E-01	9.5E-01	ca	1.9E-03	ca	2.6E-02	ca

Key: 1=IPIS n=NCEA h=HEAST x=WITHDRAWN a=Other EPA DOCUMENTS r=ROUTE EXTRAPOLATION ca=CANCER PRG nc=NONCANCER PRG sal=SOL SATURATION max=CEILING LIMIT * (where: nc < 100X ca) ** (where: nc < 10X ca)

FOR PLANNING PURPOSES

TOXICITY INFORMATION										CONTAMINANT										PRELIMINARY REMEDIATION GOALS (PRGs)					SOIL SCREENING LEVELS				
SFO 1/(mg/kg-d)	RfDo (mg/kg-d)	SFI 1/(mg/kg-d)	RfDI (mg/kg-d)	V. skin O. abs. C. soils	CAS No.											Residential Soil (mg/kg)	Industrial Soil (mg/kg)	Ambient Air (ug/m ³)	Tap Water (ug/l)	Migration to Ground Water DAF 1 (mg/kg)									
3.7E-01	x	3.7E-01	x	0	0.10	540-73-8	1,2-Dimethylhydrazine										1.3E-02	ca	6.7E-02	ca	1.8E-03	ca							
1.0E-01	h	8.6E-03		0	0.10	68-12-2	N,N-Dimethylformamide										6.1E+03	nc	8.8E+04	nc	3.1E+01	nc	3.6E+03	nc					
1.0E-03	n	1.0E-03		0	0.10	122-09-6	Dimethylphenethylamine										6.1E+01	nc	8.8E+04	nc	3.7E+00	nc	3.6E+01	nc					
2.0E-02		2.0E-02		0	0.10	105-67-9	2,4-Dimethylphenol										1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc					
6.0E-04		6.0E-04		0	0.10	576-26-1	2,6-Dimethylphenol										3.7E+01	nc	5.3E+02	nc	2.2E+00	nc	2.2E+01	nc					
1.0E-03	h	1.0E-03		0	0.10	95-65-6	3,4-Dimethylphenol										6.1E+01	nc	8.8E+02	nc	3.7E+00	nc	3.6E+01	nc					
1.0E-01	h	1.0E-01		0	0.10	131-11-3	Dimethyl phthalate										1.0E+05	max	1.0E+05	max	3.7E+04	nc	3.6E+05	nc					
1.0E-01		1.0E-01		0	0.10	120-61-6	Dimethyl terephthalate										6.1E+03	nc	8.8E+04	nc	3.7E+02	nc	3.6E+03	nc					
2.0E-03		2.0E-03		0	0.10	131-89-5	4,6-Dinitro-o-cyclohexyl phenol										1.2E+02	nc	1.8E+03	nc	7.3E+00	nc	7.3E+01	nc					
4.0E-04	h	4.0E-04		0	0.10	528-29-0	1,2-Dinitrobenzene										2.4E+01	nc	3.5E+02	nc	1.5E+00	nc	1.5E+01	nc					
1.0E-04		1.0E-04		0	0.10	99-65-0	1,3-Dinitrobenzene										6.1E+00	nc	8.8E+01	nc	3.7E-01	nc	3.6E+00	nc					
4.0E-04	h	4.0E-04		0	0.10	100-25-4	1,4-Dinitrobenzene										2.4E+01	nc	3.5E+02	nc	1.5E+00	nc	1.5E+01	nc					
2.0E-03		2.0E-03		0	0.10	51-28-5	2,4-Dinitrophenol										1.2E+02	nc	1.8E+03	nc	7.3E+00	nc	7.3E+01	nc					
6.8E-01		6.8E-01		0	0.10	25321-14-6	Dinitrotoluene mixture										7.2E-01	ca	3.6E+00	ca	9.9E-03	ca	9.9E-02	ca					
2.0E-03		2.0E-03		0	0.10	121-14-2	2,4-Dinitrotoluene (also see Dinitrotoluene mixture)										1.2E+02	nc	1.8E+03	nc	7.3E+00	nc	7.3E+01	nc					
1.0E-03	h	1.0E-03		0	0.10	606-20-2	2,6-Dinitrotoluene (also see Dinitrotoluene mixture)										6.1E+01	nc	8.8E+02	nc	3.7E+00	nc	3.6E+01	nc					
1.0E-03		1.0E-03		0	0.10	88-65-7	Dinoseb										6.1E+01	nc	8.8E+02	nc	3.7E+00	nc	3.6E+01	nc					
2.0E-02	h	1.1E-02		0	0.10	123-91-1	di-n-Octyl phthalate										1.2E+03	nc	1.0E+04	nc	7.3E+01	nc	7.3E+02	nc					
1.5E+05	h	1.5E+05	h	0	0.03	1746-01-6	1,4-Dioxane										4.4E+01	ca	2.2E+02	ca	6.1E-01	ca	6.1E+00	ca					
3.0E-02		3.0E-02		0	0.10	127-63-9	Dioxin (2,3,7,8-TCDD)										3.9E-06	ca	2.7E-05	ca	4.5E-08	ca	4.5E-07	ca					
2.5E-02		2.5E-02		0	0.10	122-39-4	Diphenylamine										1.8E+03	nc	2.6E+04	nc	1.1E+02	nc	1.1E+03	nc					
8.0E-01		7.7E-01		0	0.10	122-66-7	1,2-Diphenylhydrazine										1.5E+03	nc	2.2E+04	nc	9.1E+01	nc	9.1E+02	nc					
8.6E+00	h	8.6E+00		0	0.10	1937-37-7	Diquat										5.5E+02	nc	7.9E+03	nc	3.3E+01	nc	3.3E+02	nc					
8.1E+00	h	8.1E+00		0	0.10	2802-46-2	Direct black 38										1.3E+02	nc	1.9E+03	nc	8.0E+00	nc	8.0E+01	nc					
9.3E+00	h	9.3E+00		0	0.10	16071-88-6	Direct brown 95										5.7E-02	ca	2.9E-01	ca	7.8E-04	ca	7.8E-03	ca					
				0	0.10	298-04-4	Disulfoton										6.0E-02	ca	3.0E-01	ca	8.3E-04	ca	8.3E-03	ca					
				0	0.10	505-29-3	1,4-Dithiane										5.2E-02	ca	2.7E-01	ca	7.2E-04	ca	7.2E-03	ca					
				0	0.10	330-54-1	Diuron										2.4E+00	nc	3.5E+01	nc	1.5E-01	nc	1.5E+00	nc					
				0	0.10	115-29-7	Dodine										6.1E+02	nc	8.8E+03	nc	3.7E+01	nc	3.6E+02	nc					
				0	0.10	2439-10-3	Endosulfan										1.2E+02	nc	1.8E+03	nc	7.3E+00	nc	7.3E+01	nc					
				0	0.10	145-73-3	Endothal										2.4E+02	nc	3.5E+03	nc	1.5E+01	nc	1.5E+02	nc					
				0	0.10	72-20-8	Endrin										3.7E+02	nc	5.3E+03	nc	2.2E+01	nc	2.2E+02	nc					
				0	0.10	106-89-8	Epichlorohydrin										1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc					
				0	0.10	105-68-7	1,2-Epoxybutane										1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc					
				0	0.10	759-94-4	EPTC (S-Ethyl dipropylthiocarbamate)										2.4E+02	nc	2.2E+04	nc	9.1E+01	nc	9.1E+02	nc					
				0	0.10	16672-87-0	Etchphon (2-chloroethyl phosphonic acid)										3.1E+02	nc	4.4E+03	nc	1.8E+01	nc	1.8E+02	nc					
				0	0.10	563-12-2	Ethion										3.1E+01	nc	4.4E+02	nc	1.8E+00	nc	1.8E+01	nc					
				0	0.10	110-90-5	2-Ethoxyethanol										2.4E+04	nc	1.0E+05	max	2.1E+02	nc	1.5E+04	nc					
				0	0.10	111-15-9	2-Ethoxyethanol acetate										1.8E+04	nc	1.0E+05	max	1.1E+03	nc	1.1E+04	nc					
				0	0.10	141-78-5	Ethyl acetate										1.9E+04	nc	3.7E+04	ca	3.3E+03	nc	5.5E+03	nc					
				0	0.10	140-88-5	Ethyl acetate										2.1E-01	ca	4.5E-01	ca	1.4E-01	ca	2.3E-01	ca					
				0	0.10	100-41-4	Ethylbenzene										2.3E+02	ca	2.3E+02	ca	1.1E+03	nc	1.3E+03	nc					
				0	0.10	75-00-3	Ethyl chloride										3.0E+03	ca	6.5E+00	ca	2.3E+00	ca	4.6E+00	ca					
				0	0.10	109-78-4	Ethylene cyanohydrin										1.8E+04	nc	1.0E+05	max	1.1E+03	nc	1.1E+04	nc					
				0	0.10	107-15-3	Ethylene diamine										1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc					
				0	0.10	107-21-1	Ethylene glycol										1.0E+05	max	1.0E+05	max	7.3E+03	nc	7.3E+04	nc					
				0	0.10	111-76-2	Ethylene glycol, monobutyl ether										3.5E+02	nc	5.0E+03	nc	2.1E+01	nc	2.1E+02	nc					
				0	0.10	75-21-8	Ethylene oxide										1.4E-01	ca	3.6E-01	ca	1.9E-02	ca	2.4E-02	ca					
				0	0.10	96-45-7	Ethylene thiourea (ETU)										4.4E+00	ca**	2.2E-01	ca**	6.1E-02	ca**	6.1E-01	ca**					
				0	0.10	60-29-7	Ethyl ether										1.8E+03	sal	1.8E+03	sal	7.3E+02	nc	1.2E+03	nc					
				0	0.10	97-63-2	Ethyl methacrylate										1.4E+02	sal	1.4E+02	sal	3.3E+02	nc	5.5E+02	nc					
				0	0.10	2104-64-5	Ethyl p-nitrophenyl phenylphosphorothioate										6.1E-01	nc	8.8E+00	nc	3.7E-02	nc	3.6E-01	nc					
				0	0.10	84-72-0	Ethylphthalyl ethyl glycolate										1.0E+05	max	1.0E+05	max	1.1E+04	nc	1.1E+05	nc					

Key: i=IRIS n=NCEA h=HEAST s=WITHDRAWN o=Other EPA DOCUMENTS r=ROUTE EXTRAPOLATION ca=CANCER PRG nc=NONCANCER PRG sat=SOIL SATURATION max=CEILING LIMIT (where: nc < 100x ca) ** (where: nc < 10x ca)

FOR PLANNING PURPOSES

TOXICITY INFORMATION

CONTAMINANT

PRELIMINARY REMEDIATION GOALS (PRGs)

SOIL SCREENING LEVELS

SFO (mg/kg-d)	RfDo (mg/kg-d)	SFI 1/(mg/kg-d)	RfD (mg/kg-d)	O. abs. C. spils	CAS No.	Contaminant	Residential Soil (mg/kg)	Industrial Soil (mg/kg)	Ambient Air (ug/m ³)	Tap Water (ug/l)	Migration to Ground Water DAF 1 (mg/kg)
8.0E-03	8.0E-03	1.25E-04	2.5E-04	f 0 0 10	101200-48-0	Express	4.9E+02	7.0E+03	2.9E+01	2.9E+02	nc
2.5E-04	2.5E-04	1.3E-02	1.3E-02	f 0 0 10	22224-92-5	Penamphos	1.5E+01	2.2E+02	9.1E+01	9.1E+00	nc
1.3E-02	1.3E-02	1.3E-02	1.3E-02	f 0 0 10	2164-17-2	Fluometuron	7.9E+02	5.3E+04	4.7E+01	4.7E+02	nc
6.0E-02	6.0E-02	8.0E-02	8.0E-02	f 0 0 10	16994-48-8	Fluoride	4.9E+03	7.0E+04	2.9E+02	2.9E+03	nc
2.0E-02	2.0E-02	2.0E-02	2.0E-02	f 0 0 10	56425-91-3	Flurprimidol	1.2E+03	1.8E+04	7.3E+01	7.3E+02	nc
6.0E-02	6.0E-02	6.0E-02	6.0E-02	f 0 0 10	66332-96-5	Flutolanil	3.7E+03	5.3E+04	2.2E+02	2.2E+03	nc
1.0E-02	1.0E-02	1.0E-02	1.0E-02	f 0 0 10	69409-94-5	Fluvalinate	6.1E+02	8.8E+03	3.7E+01	3.6E+02	nc
3.5E-03	1.0E-01	3.5E-03	1.0E-01	f 0 0 10	133-07-3	Folpet	1.4E+02	7.0E+02	1.9E+00	1.9E+01	ca
1.9E-01	2.0E-03	1.9E-01	2.0E-03	f 0 0 10	72178-02-0	Fomesafen	1.2E+02	1.8E+03	7.3E+00	7.3E+01	nc
1.5E-01	1.5E-01	4.8E-02	1.5E-01	f 0 0 10	50-00-0	Fonoloss	9.2E+03	1.0E+05	1.5E-01	5.5E+03	nc
2.0E+00	2.0E+00	2.0E+00	2.0E+00	f 0 0 10	84-19-6	Formaldehyde	1.0E+05	1.0E+05	7.3E+03	7.3E+04	nc
3.0E+00	3.0E+00	3.0E+00	3.0E+00	f 0 0 10	39146-24-8	Formic Acid	1.0E+05	1.0E+05	1.1E+04	1.1E+05	nc
1.0E-03	1.0E-03	1.0E-03	1.0E-03	f 0 0 10	110-00-9	Fosetyl-al	2.5E+00	8.5E+00	3.7E+00	6.1E+00	nc
3.0E+00	3.0E+00	3.0E+00	3.0E+00	f 0 0 10	67-45-8	Furan	1.3E-01	6.5E-01	1.8E-03	1.8E-02	ca
3.0E+00	3.0E+00	3.0E+00	3.0E+00	f 0 0 10	98-01-1	Furazolidone	1.8E+02	2.6E+03	5.2E+01	1.1E+02	nc
5.0E+01	5.0E+01	5.0E+01	5.0E+01	f 0 0 10	531-82-8	Furfural	9.7E-03	4.9E-02	1.3E-04	1.3E-03	ca
3.0E+02	3.0E+02	3.0E+02	3.0E+02	f 0 0 10	60589-05-0	Furmeclorox	1.6E+01	8.2E+01	2.2E-01	2.2E+00	ca
4.0E-04	4.0E-04	4.0E-04	4.0E-04	f 0 0 10	77182-82-2	Glutamate-ammonium	2.4E+01	3.5E+02	1.5E+00	1.5E+01	nc
1.0E-04	1.0E-04	1.0E-04	1.0E-04	f 0 0 10	765-34-4	Glycidialdehyde	2.4E+01	3.5E+02	1.0E+00	1.5E+01	nc
5.0E-05	5.0E-05	5.0E-05	5.0E-05	f 0 0 10	1071-83-6	Glyphosate	6.1E+03	8.8E+04	3.7E+02	3.6E+03	nc
1.3E-02	1.3E-02	1.3E-02	1.3E-02	f 0 0 10	69808-40-2	Haloxypol-methyl	3.1E+00	4.4E+01	1.8E-01	1.8E+00	nc
1.3E-02	1.3E-02	1.3E-02	1.3E-02	f 0 0 10	79277-27-3	Harmony	7.9E+02	1.1E+04	4.7E+01	4.7E+02	nc
5.0E-04	5.0E-04	5.0E-04	5.0E-04	f 0 0 10	76-44-8	Heptachlor	1.1E-01	5.5E-01	1.5E-03	1.5E-02	ca
1.3E-03	1.3E-03	1.3E-03	1.3E-03	f 0 0 10	1024-57-3	Heptachlor epoxide	5.3E-02	2.7E-01	7.4E-04	7.4E-03	ca
2.0E-03	2.0E-03	2.0E-03	2.0E-03	f 0 0 10	87-82-1	Hexabromobenzene	1.2E+02	1.8E+03	7.3E+00	7.3E+01	nc
8.0E-04	8.0E-04	8.0E-04	8.0E-04	f 0 0 10	118-74-1	Hexachlorobenzene	3.0E-01	1.5E+00	4.2E-03	4.2E-02	ca
7.9E-02	7.9E-02	7.9E-02	7.9E-02	f 0 0 10	87-68-3	Hexachlorobutadiene	6.2E+00	3.2E-01	8.6E-01	8.6E-01	ca
8.3E+00	8.3E+00	8.3E+00	8.3E+00	f 0 0 04	319-94-8	HCH (alpha)	9.0E-02	5.9E-01	1.1E-03	1.1E-02	ca
1.9E+00	1.9E+00	1.9E+00	1.9E+00	f 0 0 04	319-85-7	HCH (beta)	3.2E-01	2.1E+00	3.7E-03	3.7E-02	ca
1.3E+00	1.3E+00	1.3E+00	1.3E+00	f 0 0 04	58-89-9	HCH (gamma)	4.4E-01	2.9E+00	5.2E-03	5.2E-02	ca
1.9E+00	1.9E+00	1.9E+00	1.9E+00	f 0 0 04	609-73-1	HCH-technical	3.2E-01	2.1E+00	3.8E-03	3.7E-02	ca
8.2E+03	8.2E+03	8.2E+03	8.2E+03	f 0 0 10	19498-74-3	Hexachlorocyclopentadiene	4.2E+02	5.9E+03	7.3E-02	2.6E+02	nc
1.4E-02	1.4E-02	1.4E-02	1.4E-02	f 0 0 10	67-72-1	Hexachlorobenzene	7.8E-05	4.0E-04	1.5E-06	1.1E-05	ca
3.0E-04	3.0E-04	3.0E-04	3.0E-04	f 0 0 10	70-30-4	Hexachloroethane	3.5E+01	1.8E+02	4.8E-01	4.8E+00	ca
1.1E-01	1.1E-01	1.1E-01	1.1E-01	f 0 0 10	121-82-4	Hexahydro-1,3,5-triazine	1.8E+01	2.6E+02	1.1E+00	1.1E+01	nc
2.9E-06	2.9E-06	2.9E-06	2.9E-06	f 0 0 10	822-86-0	n-Hexane	1.7E-01	2.5E+00	1.0E-02	1.0E-01	nc
6.0E-02	6.0E-02	6.0E-02	6.0E-02	f 0 0 10	51235-04-2	Hexazinone	1.1E+02	1.1E+02	2.1E+02	3.5E+02	nc
3.3E-02	3.3E-02	3.3E-02	3.3E-02	f 0 0 10	302-01-2	Hydrazine	2.0E+03	2.9E+04	1.2E+02	1.2E+03	nc
3.0E+00	3.0E+00	3.0E+00	3.0E+00	f 0 0 10	7647-01-0	Hydrazine sulfate	1.6E-01	8.2E-01	3.9E-04	2.2E-02	ca
4.0E-02	4.0E-02	4.0E-02	4.0E-02	f 0 0 10	7783-08-4	Hydrogen chloride	2.4E+03	3.5E+04	1.5E+02	1.5E+03	nc
2.5E-01	2.5E-01	2.5E-01	2.5E-01	f 0 0 10	123-31-9	p-Hydroquinone	7.9E+02	1.1E+04	4.7E+01	4.7E+02	nc
4.0E-02	4.0E-02	4.0E-02	4.0E-02	f 0 0 10	36554-44-0	Imazali	1.5E+04	1.0E+05	9.1E+02	9.1E+03	nc
3.0E-01	3.0E-01	3.0E-01	3.0E-01	f 0 0 10	61335-37-7	Imazaquin	2.4E+03	3.5E+04	1.5E+02	1.5E+03	nc
3.0E-01	3.0E-01	3.0E-01	3.0E-01	f 0 0 10	36734-18-7	Iprodione	2.3E+04	1.0E+05	1.1E+03	1.1E+04	nc
3.0E-01	3.0E-01	3.0E-01	3.0E-01	f 0 0 10	7439-89-6	Iron	1.3E+04	4.0E+04	7.1E+03	7.1E+04	nc
3.0E-01	3.0E-01	3.0E-01	3.0E-01	f 0 0 10	78-53-1	Isobutanol	5.1E+02	2.6E+03	7.1E+00	7.1E+01	ca
3.0E-01	3.0E-01	3.0E-01	3.0E-01	f 0 0 10	33820-53-0	Isophorane	9.2E+02	1.3E+04	5.5E+01	5.5E+02	nc
1.5E-02	1.5E-02	1.5E-02	1.5E-02	f 0 0 10	1832-54-8	Isopropalin	6.1E+03	8.8E+04	4.0E+02	3.6E+03	nc
1.0E-01	1.0E-01	1.0E-01	1.0E-01	f 0 0 10	62558-50-7	Isopropyl methyl phosphonic acid	3.1E+03	4.4E+04	1.8E+02	1.8E+03	nc
5.0E-02	5.0E-02	5.0E-02	5.0E-02	f 0 0 10	143-50-0	Isosabalin	2.7E-02	1.4E-01	3.7E-04	3.7E-03	ca
2.0E-03	2.0E-03	2.0E-03	2.0E-03	f 0 0 10	77501-83-4	Kepone	1.2E+02	1.8E+03	7.3E+00	7.3E+01	nc
1.8E+01	1.8E+01	1.8E+01	1.8E+01	f 0 0 10	77501-83-4	Lactolene	1.2E+02	1.8E+03	7.3E+00	7.3E+01	nc

Key: I=IRIS n=NCEA h=HEAST x=WITHDRAWN a=Other EPA DOCUMENTS r=ROUTE EXTRAPOLATION ca=CANCER PRG nc=NONCANCER PRG sat=SOIL SATURATION max=CEILING LIMIT *(where: nc < 100X ca) ** (where: nc < 10X ca)

FOR PLANNING PURPOSES

TOXICITY INFORMATION

CONTAMINANT

PRELIMINARY REMEDIATION GOALS (PRGs)

SOIL SCREENING LEVELS

SFO	FI/Do	SFI	RID	V	CAS No.	Contaminant	Residential Soil (mg/kg)	Industrial Soil (mg/kg)	Ambient Air (ug/m ³)	Tap Water (ug/l)	Migration to Ground Water DAF 20 (mg/kg)	DAF 1 (mg/kg)
1/(mg/kg-d)	1/(mg/kg-d)	1/(mg/kg-d)	1/(mg/kg-d)	O abs.								
PRGs Based on EPA Media, IEUBX (1994) and TRW (1996)												
1.0E-07	1			0	7439-92-1	Lead (tetraethyl)	4.0E+02	1.0E+03	nc			
2.0E-03	1			0	78-00-2	Lead	6.1E+03	8.8E+02	nc	3.6E-03	nc	
2.0E-03	1			0	330-55-2	Linuron	1.2E+02	1.8E+03	nc	7.3E+01	nc	
2.0E-02	x			0	7439-93-2	Lithium	1.6E+03	4.1E+04	nc	7.3E+02	nc	
2.0E-01	1			0	83055-99-5	Londax	1.2E+04	1.0E+05	max	7.3E+03	nc	
2.0E-02	1			0	121-75-5	Malathion	1.2E+03	1.8E+04	nc	7.3E+01	nc	
1.0E-01	1			0	108-31-6	Maleic anhydride	6.1E+03	8.8E+04	nc	3.7E+02	nc	
5.0E-01	1			0	123-33-1	Maleic hydrazide	1.7E+03	2.4E+03	sal	1.8E+03	nc	
2.0E-05	h			0	109-77-3	Malononitrile	1.2E+00	1.8E+01	nc	7.3E-01	nc	
3.0E-02	h			0	8018-01-7	Mancozeb	1.8E+03	2.6E+04	nc	1.1E+02	nc	
6.0E-02	o			0	12427-38-2	Maneb	8.1E+00	4.1E+01	ca	1.1E+01	ca	
2.4E-02	1			0	7439-96-5	Manganese and compounds	1.8E+03	3.2E+04	5.1E-02	8.8E+02	nc	
9.0E-05	h			0	950-10-7	Mephosfolan	5.5E+00	7.9E+01	nc	3.3E-01	nc	
3.0E-02	1			0	24307-28-4	Mepiquat	1.8E+03	2.6E+04	nc	1.1E+02	nc	
2.9E-02	n			0	149-30-4	2-Mercaptobenzothiazole	1.7E+01	8.5E+01	ca	2.3E-01	ca	
3.0E-04	1			0	7487-54-7	Mercury and compounds	2.3E+01	6.1E+02	nc	1.1E+01	nc	
1.0E-04	1			0	7439-97-6	Mercury (elemental)	6.1E+00	8.8E+01	nc	3.6E+00	nc	
3.0E-05	1			0	22967-92-8	Mercury (methyl)	1.8E+00	2.6E+01	nc	1.1E-01	nc	
3.0E-05	1			0	150-50-5	Merphos	1.8E+00	2.6E+01	nc	1.1E-01	nc	
3.0E-05	1			0	78-48-8	Merphos oxide	3.7E+03	5.3E+04	nc	2.2E+02	nc	
6.0E-02	1			0	57637-19-1	Metolaxyl	2.1E+00	8.8E+00	nc	7.3E-01	nc	
1.0E-04	1			0	126-99-7	Methacrylonitrile	3.1E+00	4.4E+01	nc	1.8E+00	nc	
5.0E-05	1			0	10265-92-6	Methamidophos	3.1E+04	1.0E+05	max	1.8E+03	nc	
5.0E-01	1			0	67-59-1	Methand	6.1E+01	8.8E+02	nc	3.7E+00	nc	
1.0E-03	1			0	16752-77-5	Methidathion	4.4E+01	1.5E+02	nc	1.5E+02	nc	
2.5E-02	1			0	72-43-5	Methomyl	3.1E+02	4.4E+03	nc	1.8E+01	nc	
5.0E-03	1			0	109-86-4	Methoxychlor	6.1E+01	8.8E+02	nc	2.7E+01	nc	
1.0E-03	h			0	110-49-6	2-Methoxyethanol	1.2E+02	1.8E+03	nc	7.3E+00	nc	
2.0E-03	h			0	99-59-2	2-Methoxy-5-nitroaniline	1.1E+01	5.4E+01	ca	1.5E-01	ca	
4.8E-02	h			0		Methyl acetate	2.2E+04	9.6E+04	nc	3.7E+03	nc	
1.0E+00	h			0	79-20-9	Methyl acrylate	7.0E+01	2.3E+02	nc	1.1E+02	nc	
3.0E-02	h			0	96-33-3	2-Methylaniline (o-toluidine)	2.0E+00	1.0E+01	ca	2.8E-02	ca	
1.8E-01	h			0	68-21-5	2-Methylaniline hydrochloride	2.7E+00	1.4E+01	ca	3.7E-02	ca	
1.0E+00	x			0	79-22-1	Methyl chlorocarbonate	6.1E+04	1.0E+05	max	3.7E+03	nc	
5.0E-04	1			0	84-74-8	2-Methyl-4-chlorophenoxyacetic acid	3.1E+01	4.4E+02	nc	1.8E+00	nc	
1.0E-02	1			0	94-81-5	4-(2-Methyl-4-chlorophenoxy) butyric acid	6.1E+02	8.8E+03	nc	3.7E+01	nc	
1.0E-03	1			0	93-65-2	2-(2-Methyl-4-chlorophenoxy) propionic acid	6.1E+01	8.8E+02	nc	3.7E+00	nc	
1.0E-03	1			0	16494-77-8	2-(2-Methyl-1,4-chlorophenoxy) propionic acid	2.6E+03	8.8E+03	nc	3.1E+03	nc	
8.8E-01	1			0	109-67-2	Methylcyclohexane	1.9E+00	9.9E+00	ca	2.7E-02	ca	
2.5E-01	h			0	101-77-9	4,4'-Methylenbisbenzenamine	1.1E+01	5.4E+01	ca	1.5E-01	ca	
1.3E-04	h			0	101-14-4	4,4'-Methylene bis(2-chloroaniline)	6.7E+01	2.4E+02	ca	3.7E+01	nc	
4.6E-02	1			0	101-61-1	4,4'-Methylene bis(N,N-dimethyl)aniline	1.1E+01	5.4E+01	ca	1.5E-01	ca	
7.5E-03	1			0	74-95-3	Methylene bromide	6.7E+01	2.4E+02	ca	3.7E+01	nc	
1.7E-04	1			0	101-68-8	Methylene chloride	8.9E+00	2.1E+01	ca	4.1E+00	ca	
6.0E-01	1			0	78-93-3	4,4'-Methylene diphenyl diisocyanate	1.0E+01	1.5E+02	nc	6.2E-01	nc	
1.1E+00	h			0	50-34-4	Methyl hydrazine	7.9E+02	2.9E+03	nc	8.3E-01	nc	
8.0E-02	h			0	108-10-1	Methyl isobutyl ketone	3.5E+01	5.0E+02	nc	2.1E+00	nc	
5.7E-04	1			0	74-93-1	Methyl Mercaptan	7.3E+03	2.8E+04	nc	1.0E+03	nc	
1.4E+00	1			0	80-82-6	Methyl methacrylate	4.4E-01	2.2E+00	ca	6.1E-02	ca	
3.3E-02	h			0	99-55-6	2-Methyl-5-nitroaniline	1.5E+01	7.5E+01	ca	2.0E-01	ca	
2.5E-04	1			0	298-00-0	Methyl parathion	1.5E+01	2.2E+02	nc	9.1E-01	nc	
5.0E-02	1			0	95-48-7	3-Methylphenol	3.1E+03	4.4E+04	nc	1.8E+02	nc	
5.0E-02	h			0	108-39-4	4-Methylphenol	3.1E+02	4.4E+03	nc	1.8E+01	nc	

2E+02 8E+00

2E-02 1E-03

2E+01 8E-01

Key: I=IRIS; H=HEAST; N=NCEA; H=HEAST; W=WITHDRAWN; O=Other EPA DOCUMENTS; R=ROUTE EXTRAPOLATION; CB=CANCER PRG; NC=NONCANCER PRG; SAL=SOIL SATURATION; MAX=CEILING LIMIT; *where: nc < 100% ca; **where: nc < 10% ca

FOR PLANNING PURPOSES

TOXICITY INFORMATION						CONTAMINANT		PRELIMINARY REMEDIATION GOALS (PRGs)				SOIL SCREENING LEVELS	
SFO 1/(mg/kg-d)	RfD (mg/kg-d)	SF1 1/(mg/kg-d)	RfD1 (mg/kg-d)	V	skin O:abs C:sols	CAS No.		Residential Soil (mg/kg)	Industrial Soil (mg/kg)	Ambient Air (µg/m ³)	Tap Water (µg/l)	Migration to Ground Water DAF 20 (mg/kg)	DAF 1 (mg/kg)
6.0E-03	h	1.1E-02	h	1	0.10	993-13-5	Methyl phosphonic acid	1.2E+03	1.8E+04	nc	7.3E+02	nc	
7.0E-02	h	7.0E-02	h	1	0.10	25013-15-4	Methyl styrene (mixture)	1.3E+02	5.8E+02	nc	6.0E+01	nc	
8.6E-01	h	8.6E-01	h	1	0.10	99-83-9	Methyl styrene (alpha)	6.8E+02	6.8E+02	sal	4.3E+02	nc	
1.5E-01	h	1.5E-01	h	1	0.10	1834-01-4	Methyl tertbutyl ether (MTBE)	9.2E+03	1.0E+05	max	5.5E+02	nc	
2.5E-02	h	2.5E-02	h	1	0.10	51216-45-2	Metolacolor (Dual)	1.5E+03	2.2E+04	nc	9.1E+01	nc	
1.8E+00	x	1.8E+00	h	1	0.10	21097-64-9	Metribuzin	2.7E-01	1.4E+00	ca	3.7E+02	nc	
2.0E-03	h	2.0E-03	h	1	0.10	2385-85-5	Mirex	1.2E+02	1.8E+03	nc	7.3E+01	nc	
5.0E-03	h	5.0E-03	h	1	0.10	2212-57-1	Molinate	3.9E+02	1.0E+04	nc	1.8E+02	nc	
1.0E-01	h	1.0E-01	h	0	0.10	7439-98-7	Molybdenum	6.1E+03	8.8E+04	nc	3.6E+03	nc	
2.0E-03	h	2.0E-03	h	0	0.10	10599-90-3	Monochloramine	1.2E+02	1.8E+03	nc	7.3E+01	nc	
1.0E-01	h	1.0E-01	h	0	0.10	300-76-5	Naled	1.2E+02	1.8E+03	nc	7.3E+01	nc	
2.0E-02	h	2.0E-02	h	0	0.10	15299-99-7	Napropamide	6.1E+03	8.8E+04	nc	3.6E+03	nc	
2.0E-02	h	2.0E-02	h	0	0.10	7440-02-0	Nickel (soluble salts)	1.6E+03	4.1E+04	nc	7.3E+02	nc	7E+00
"CAL-Modified PRG" (PEA, 1994)													
8.4E-01	h	8.4E-01	h	0	0	12035-72-2	Nickel refinery dust	1.5E+02	8.0E-03	ca			
1.7E+00	h	1.7E+00	h	0	0	1929-82-4	Nickel subsulfide	9.2E+01	1.1E+04	ca	5.5E+01	nc	
1.5E-03	x	1.5E-03	h	0	0.10	14797-55-8	Nitrapryn	9.2E+01	1.3E+03	nc	1.0E+04	nc	
1.0E-01	x	1.0E-01	h	0	0.10	10102-43-9	Nitrate	7.8E+03	1.0E+05	max	3.6E+03	nc	
Nitric Oxide													
Nitrite													
5.7E-05	h	5.7E-05	h	0	0.10	88-74-4	2-Nitroaniline	3.5E+00	5.0E+01	nc	2.1E-01	nc	
5.0E-04	h	5.7E-04	h	1	0.10	98-95-3	Nitrobenzene	2.0E+01	1.1E+02	nc	2.1E+00	nc	
7.0E-02	h	7.0E-02	h	0	0.10	67-20-8	Nitrolaurantoin	4.3E+03	6.2E+04	nc	2.6E+02	nc	
1.5E+00	h	9.4E+00	h	0	0.10	59-87-0	Nitrolurazone	3.2E-01	1.6E+00	ca	4.5E-02	ca	
1.4E-02	h	1.4E-02	h	0	0.10	55-83-0	Nitroglycerin	3.5E+01	1.8E+02	ca	4.8E-01	ca	
1.0E-01	h	1.0E-01	h	0	0.10	55-88-7	Nitroguanidine	6.1E+03	8.8E+04	nc	3.6E+03	nc	
8.0E-03	h	8.0E-03	h	0	0.10	100-02-7	4-Nitrophenol	4.9E+02	7.0E+03	nc	2.9E+01	nc	
5.7E-03	h	5.7E-03	h	1	0.10	79-46-9	2-Nitropropane	2.4E-02	6.1E-02	ca	1.2E-03	ca	
5.4E+00	h	5.6E+00	h	1	0.10	924-16-3	N-Nitrosodimethylamine	1.7E-01	8.8E-01	ca	2.4E-03	ca	
2.8E+00	h	2.8E+00	h	0	0.10	1116-54-7	N-Nitrosodiphenylamine	3.2E-03	1.6E-02	ca	4.5E-05	ca	
1.5E+02	h	1.8E+02	h	0	0.10	55-18-5	N-Nitrosodiethylamine	9.5E-03	4.8E-02	ca	1.4E-04	ca	
5.1E+01	h	4.9E+01	h	0	0.10	6275-9	N-Nitrosodimethylamine	9.9E+01	5.0E+02	ca	1.4E+00	ca	
4.9E+03	h	4.9E+03	h	0	0.10	85-30-8	N-Nitrosodiphenylamine	6.9E-02	3.5E-01	ca	9.6E-04	ca	
7.0E+00	h	7.0E+00	h	0	0.10	621-64-7	N-Nitroso di-n-propylamine	2.2E-02	1.1E-01	ca	3.1E-04	ca	
2.2E+01	h	2.2E+01	h	0	0.10	10595-96-6	N-Nitroso-N-methylamine	2.3E-01	1.2E+00	ca	3.2E-02	ca	
2.1E+00	h	2.1E+00	h	0	0.10	930-55-2	N-Nitrosopyrrolidine	3.7E+02	1.00E+03	sal	3.7E+01	nc	
1.0E-02	h	1.0E-02	h	1	0.10	99-08-1	m-Nitrotoluene	3.7E+02	1.00E+03	sal	6.1E+01	nc	
1.0E-02	h	1.0E-02	h	1	0.10	99-08-1	o-Nitrotoluene	3.7E+02	1.00E+03	sal	6.1E+01	nc	
4.0E-02	h	4.0E-02	h	0	0.10	27314-13-2	Nitrofurazone	4.3E+01	6.2E+02	nc	2.6E+00	nc	
7.0E-04	h	7.0E-04	h	0	0.10	85509-19-9	NUSIAR	1.8E+02	2.6E+03	nc	1.1E+01	nc	
3.0E-03	h	3.0E-03	h	0	0.10	32536-52-0	Octamodiphenyl ether	3.1E+03	4.4E+04	nc	1.8E+02	nc	
5.0E-02	h	5.0E-02	h	0	0.10	2691-41-0	Octahydro-1357-tetranitro-1357-tetrazocine (HMX)	1.2E+02	1.8E+03	nc	7.3E+01	nc	
2.0E-03	h	2.0E-03	h	0	0.10	152-16-9	Octamethylpyrophosphoramide	3.1E+03	4.4E+04	nc	1.8E+03	nc	
5.0E-02	h	5.0E-02	h	0	0.10	19044-98-3	Orvazalin	3.1E+02	4.4E+03	nc	1.8E+02	nc	
5.0E-03	h	5.0E-03	h	0	0.10	19668-30-9	Oxadiazon	1.5E+03	2.2E+04	nc	9.1E+01	nc	
2.5E-02	h	2.5E-02	h	0	0.10	23135-22-0	Oxamyl	1.8E+02	2.6E+03	nc	1.1E+01	nc	
3.0E-03	h	3.0E-03	h	0	0.10	42874-03-3	Oxyluorfen	7.9E+02	1.1E+04	nc	4.7E+01	nc	
1.3E-02	h	1.3E-02	h	0	0.10	76738-62-0	Paracutrazol	2.7E+02	4.0E+03	nc	1.6E+01	nc	
4.5E-03	h	4.5E-03	h	0	0.10	4685-14-7	Paracut	3.7E+02	5.3E+03	nc	2.2E+01	nc	
6.0E-03	h	6.0E-03	h	0	0.10	56-38-2	Parathion	3.1E+03	4.4E+04	nc	1.8E+02	nc	
5.0E-02	h	5.0E-02	h	0	0.10	1114-71-2	Pebulate	2.4E+03	3.5E+04	nc	1.5E+03	nc	
4.0E-02	h	4.0E-02	h	0	0.10	40467-42-1	Pendimethalin	2.1E+01	1.1E+02	ca	2.9E+01	ca	
2.3E-02	h	2.3E-02	h	0	0.10	87-84-3	Pentabromo-6-chloro cyclohexane	1.2E+02	1.8E+03	nc	7.3E+01	nc	
2.0E-03	h	2.0E-03	h	0	0.10	32534-81-9	Pentabromodiphenyl ether	4.9E+01	7.0E+02	nc	2.9E+00	nc	
8.0E-04	h	8.0E-04	h	0	0.10	608-93-5	Pentachlorobenzene						

Key: I=IRIS n=NCEA h=HEAST x=WITHDRAWN o=Other EPA DOCUMENTS r=ROUTE EXTRAPOLATION ca=CANCER PRG nc=NONCANCER PRG s=SOIL SATURATION max=CEILING LIMIT * (where: nc < 100X ca) ** (where: nc < 10X ca)

FOR PLANNING PURPOSES

TOXICITY INFORMATION				CONTAMINANT				PRELIMINARY REMEDIATION GOALS (PRGs)				SOIL SCREENING LEVELS			
SPQ 1/(mg/kg-d)	RfD (mg/kg-d)	SF 1/(mg/kg-d)	RfD (mg/kg-d)	V O. ads C. soils	CAS No.	Contaminant	Residential Soil (mg/kg)	Industrial Soil (mg/kg)	Ambient Air (µg/m³)	Tap Water (µg/l)	Migration to Ground Water DAF 20 (mg/kg)	DAF 1 (mg/kg)	DAF 20 (mg/kg)	DAF 1 (mg/kg)	DAF 20 (mg/kg)
2.0E-01	3.0E-03	1.2E-01	3.0E-03	0	82-68-8	Pentachloronitrobenzene	1.9E+00	9.5E+00	2.6E-02	2.6E-01	3E-02	1E-03	3E-02	1E-03	3E-02
1.2E-01	3.0E-03	1.2E-01	3.0E-03	0	87-86-5	Pentachlorophenol	3.9E+01	1.0E+03	5.6E-02	5.6E-01	3E-02	1E-03	3E-02	1E-03	3E-02
5.0E-04	5.0E-02	2.5E-01	5.0E-02	0	52645-53-1	Perchlorate	3.1E+03	4.4E+04	1.8E+02	1.8E+03	1E+02	5E+00	1E+02	5E+00	1E+02
2.5E-01	2.5E-01	2.5E-01	2.5E-01	0	19884-63-4	Permethrin	1.5E+04	1.0E+05	2.2E+03	2.2E+04	1E+02	5E+00	1E+02	5E+00	1E+02
6.0E-01	6.0E-03	6.0E-03	6.0E-03	0	82-34-2	Phenmedipham	3.7E+04	1.0E+05	2.2E+03	2.2E+04	1E+02	5E+00	1E+02	5E+00	1E+02
2.0E-03	2.0E-03	2.0E-03	2.0E-03	0	82-34-2	Phenothiazine	1.2E+02	1.8E+03	7.3E+00	7.3E+01	1E+02	5E+00	1E+02	5E+00	1E+02
6.0E-03	6.0E-03	6.0E-03	6.0E-03	0	108-45-2	m-Phenylenediamine	3.7E+02	5.3E+03	2.2E+01	2.2E+02	1E+02	5E+00	1E+02	5E+00	1E+02
1.9E-01	1.9E-01	1.9E-01	1.9E-01	0	108-45-2	p-Phenylenediamine	1.2E+04	1.0E+05	6.9E+02	6.9E+03	1E+02	5E+00	1E+02	5E+00	1E+02
8.0E-05	8.0E-05	8.0E-05	8.0E-05	0	62-38-4	Phenylmercuric acetate	4.9E+00	7.0E+01	2.9E-01	2.9E+00	1E+02	5E+00	1E+02	5E+00	1E+02
1.9E-03	1.9E-03	1.9E-03	1.9E-03	0	50-43-7	2-Phenylphenol	2.5E+02	1.3E+03	3.5E+00	3.5E+01	1E+02	5E+00	1E+02	5E+00	1E+02
2.0E-04	2.0E-04	2.0E-04	2.0E-04	0	298-02-2	Priorate	1.2E+01	1.8E+02	7.3E-01	7.3E+00	1E+02	5E+00	1E+02	5E+00	1E+02
2.0E-02	2.0E-02	2.0E-02	2.0E-02	0	732-11-6	Phosmet	1.2E+03	1.8E+04	7.3E+01	7.3E+02	1E+02	5E+00	1E+02	5E+00	1E+02
3.0E-04	3.0E-04	3.0E-04	3.0E-04	0	7803-51-2	Phosphine	1.8E+01	2.6E+02	3.1E-01	3.1E+01	1E+02	5E+00	1E+02	5E+00	1E+02
2.0E-05	2.0E-05	2.0E-05	2.0E-05	0	7664-39-2	Phosphoric acid	1.6E+00	4.1E+01	7.3E-01	7.3E+01	1E+02	5E+00	1E+02	5E+00	1E+02
1.0E-00	1.0E-00	1.0E-00	1.0E-00	0	7725-14-0	Phosphorus (white)	6.1E+04	1.0E+05	3.7E+03	3.7E+04	1E+02	5E+00	1E+02	5E+00	1E+02
2.0E+00	2.0E+00	2.0E+00	2.0E+00	0	100-21-0	p-Phthalic acid	1.0E+05	1.0E+05	1.2E+02	1.2E+03	1E+02	5E+00	1E+02	5E+00	1E+02
7.0E-02	7.0E-02	7.0E-02	7.0E-02	0	85-44-9	Phthalic anhydride	4.3E+03	6.2E+04	2.6E+02	2.6E+03	1E+02	5E+00	1E+02	5E+00	1E+02
1.0E-02	1.0E-02	1.0E-02	1.0E-02	0	1918-02-1	Picloram	6.1E+02	8.8E+03	3.7E+01	3.7E+02	1E+02	5E+00	1E+02	5E+00	1E+02
8.9E-00	8.9E-00	8.9E-00	8.9E-00	0	23505-41-1	Pirimiphos-methyl	5.5E-02	2.8E-01	7.8E-04	7.8E-03	1E+02	5E+00	1E+02	5E+00	1E+02
2.0E+00	2.0E+00	2.0E+00	2.0E+00	0	1336-36-3	Polybrominated biphenyls	2.2E-01	1.0E+00	3.4E-03	3.4E-02	1E+02	5E+00	1E+02	5E+00	1E+02
7.0E-02	7.0E-02	7.0E-02	7.0E-02	0	12674-11-2	Polychlorinated biphenyls (PCBs)	3.9E+00	2.9E+01	9.6E-02	9.6E-01	1E+02	5E+00	1E+02	5E+00	1E+02
3.0E+00	3.0E+00	3.0E+00	3.0E+00	0	11104-28-2	Aroclor 1016	2.2E-01	1.0E+00	3.4E-03	3.4E-02	1E+02	5E+00	1E+02	5E+00	1E+02
2.0E+00	2.0E+00	2.0E+00	2.0E+00	0	11141-16-5	Aroclor 1221	2.2E-01	1.0E+00	3.4E-03	3.4E-02	1E+02	5E+00	1E+02	5E+00	1E+02
2.0E+00	2.0E+00	2.0E+00	2.0E+00	0	53489-21-9	Aroclor 1232	2.2E-01	1.0E+00	3.4E-03	3.4E-02	1E+02	5E+00	1E+02	5E+00	1E+02
2.0E+00	2.0E+00	2.0E+00	2.0E+00	0	12672-29-6	Aroclor 1248	2.2E-01	1.0E+00	3.4E-03	3.4E-02	1E+02	5E+00	1E+02	5E+00	1E+02
2.0E+00	2.0E+00	2.0E+00	2.0E+00	0	11097-69-1	Aroclor 1254	2.2E-01	1.0E+00	3.4E-03	3.4E-02	1E+02	5E+00	1E+02	5E+00	1E+02
2.0E+00	2.0E+00	2.0E+00	2.0E+00	0	11098-82-5	Aroclor 1260	2.2E-01	1.0E+00	3.4E-03	3.4E-02	1E+02	5E+00	1E+02	5E+00	1E+02
8.0E-02	8.0E-02	8.0E-02	8.0E-02	0	63-32-9	Polynuclear aromatic hydrocarbons (PAHs)	3.7E+03	3.8E+04	2.2E+02	2.2E+03	1E+02	5E+00	1E+02	5E+00	1E+02
3.0E-01	3.0E-01	3.0E-01	3.0E-01	0	120-12-7	Acenaphthene	2.2E+04	1.0E+05	1.1E+03	1.1E+04	1E+02	5E+00	1E+02	5E+00	1E+02
7.3E-01	7.3E-01	7.3E-01	7.3E-01	0	56-55-3	Anthracene	6.2E-01	2.9E+00	2.2E-02	2.2E-03	1E+02	5E+00	1E+02	5E+00	1E+02
7.3E-01	7.3E-01	7.3E-01	7.3E-01	0	205-99-2	Benz[a]anthracene	6.2E-01	2.9E+00	2.2E-02	2.2E-03	1E+02	5E+00	1E+02	5E+00	1E+02
7.3E-02	7.3E-02	7.3E-02	7.3E-02	0	207-06-8	Benz[b]fluoranthene	6.2E-01	2.9E+00	2.2E-02	2.2E-03	1E+02	5E+00	1E+02	5E+00	1E+02
7.3E-02	7.3E-02	7.3E-02	7.3E-02	0	193-39-5	Benz[k]fluoranthene	6.2E-01	2.9E+00	2.2E-02	2.2E-03	1E+02	5E+00	1E+02	5E+00	1E+02
7.3E-02	7.3E-02	7.3E-02	7.3E-02	0	91-20-3	"CAL-Modified PRG" (PEA, 1994)	6.1E-01	2.9E+00	2.2E-02	2.2E-03	1E+02	5E+00	1E+02	5E+00	1E+02
7.3E-02	7.3E-02	7.3E-02	7.3E-02	0	50-32-8	Benzofluoranthene	6.2E-02	2.9E-01	2.2E-03	2.2E-04	1E+02	5E+00	1E+02	5E+00	1E+02
7.3E-03	7.3E-03	7.3E-03	7.3E-03	0	218-01-9	Chrysene	6.2E-01	2.9E+02	2.2E+00	2.2E+01	1E+02	5E+00	1E+02	5E+00	1E+02
7.3E-00	7.3E-00	7.3E-00	7.3E-00	0	53-70-3	"CAL-Modified PRG" (PEA, 1994)	6.1E+00	2.9E+02	2.2E+00	2.2E+01	1E+02	5E+00	1E+02	5E+00	1E+02
7.3E-00	7.3E-00	7.3E-00	7.3E-00	0	206-44-0	Dibenz[ah]anthracene	6.2E-02	2.9E-01	2.2E-03	2.2E-04	1E+02	5E+00	1E+02	5E+00	1E+02
7.3E-01	7.3E-01	7.3E-01	7.3E-01	0	56-73-7	Fluoranthene	2.3E+03	3.0E+04	1.5E+02	1.5E+03	1E+02	5E+00	1E+02	5E+00	1E+02
7.3E-01	7.3E-01	7.3E-01	7.3E-01	0	183-39-5	Indeno[1,2,3-cd]pyrene	2.6E+03	3.3E+04	1.5E+02	1.5E+03	1E+02	5E+00	1E+02	5E+00	1E+02
7.3E-01	7.3E-01	7.3E-01	7.3E-01	0	193-39-5	Naphthalene	6.2E-01	2.9E+00	2.2E-02	2.2E-03	1E+02	5E+00	1E+02	5E+00	1E+02
7.3E-01	7.3E-01	7.3E-01	7.3E-01	0	91-20-3	Pyrene	5.6E-01	1.9E+02	3.1E+00	3.1E+01	1E+02	5E+00	1E+02	5E+00	1E+02
1.5E-01	1.5E-01	1.5E-01	1.5E-01	0	129-00-0	Prochloraz	2.3E+03	3.0E+04	1.5E+02	1.5E+03	1E+02	5E+00	1E+02	5E+00	1E+02
1.5E-01	1.5E-01	1.5E-01	1.5E-01	0	67747-09-5	Proluralin	3.2E+00	5.4E+04	1.1E+02	1.1E+03	1E+02	5E+00	1E+02	5E+00	1E+02
1.5E-01	1.5E-01	1.5E-01	1.5E-01	0	1810-18-0	Prometon	3.7E+02	5.3E+03	2.2E+01	2.2E+02	1E+02	5E+00	1E+02	5E+00	1E+02
1.5E-01	1.5E-01	1.5E-01	1.5E-01	0	7287-19-6	Prometryn	9.2E+02	1.3E+04	5.5E+01	5.5E+02	1E+02	5E+00	1E+02	5E+00	1E+02
1.5E-01	1.5E-01	1.5E-01	1.5E-01	0	23550-56-5	Promazine	4.6E+03	6.6E+04	2.7E+02	2.7E+03	1E+02	5E+00	1E+02	5E+00	1E+02
1.5E-01	1.5E-01	1.5E-01	1.5E-01	0	1918-16-7	Propachlor	7.9E+02	1.1E+04	4.7E+01	4.7E+02	1E+02	5E+00	1E+02	5E+00	1E+02
1.5E-01	1.5E-01	1.5E-01	1.5E-01	0	709-98-6	Propanil	3.1E+02	1.1E+04	4.7E+01	4.7E+02	1E+02	5E+00	1E+02	5E+00	1E+02
2.0E-02	2.0E-02	2.0E-02	2.0E-02	0	2312-35-8	Propargyl alcohol	1.2E+03	1.8E+04	7.3E+01	7.3E+02	1E+02	5E+00	1E+02	5E+00	1E+02
2.0E-03	2.0E-03	2.0E-03	2.0E-03	0	107-19-7	Propargyl alcohol	1.2E+03	1.8E+04	7.3E+01	7.3E+02	1E+02	5E+00	1E+02	5E+00	1E+02
2.0E-02	2.0E-02	2.0E-02	2.0E-02	0	138-40-2	Propazine	1.2E+03	1.8E+04	7.3E+01	7.3E+02	1E+02	5E+00	1E+02	5E+00	1E+02

Key: L=HHS, N=NCEA, H=HEAST, W=WITHDRAWN, O=Other EPA DOCUMENTS, E=ROUTE EXTRA-POLATION, C=CANCER PRG, NC=NONCANCER PRG, S=SOL SATURATION, MAX=CELLING LIMIT, * (where, NC < 100X CA), ** (where, NC < 10X CA)

FOR PLANNING PURPOSES

TOXICITY INFORMATION

CONTAMINANT

PRELIMINARY REMEDIATION GOALS (PRGs)

SOIL SCREENING LEVELS

SFO (mg/kg-d)	RfDO (mg/kg-d)	SFI (mg/kg-d)	RfDO (mg/kg-d)	V skin O abs C soils	CAS No.	Contaminant	Residential Soil (mg/kg)	Industrial Soil (mg/kg)	Ambient Air (ug/m ³)	Tap Water (ug/l)	Migration to Ground Water DAF 20 (mg/kg)
2.0E-02	1	1.0E-01	1.0E-01	0	122-42-9	Propylamine	1.2E+03	1.8E+04	7.3E+01	7.3E+02	NC
1.3E-02	1	1.3E-02	1.3E-02	0	60207-90-1	Propionazole	7.9E+02	1.1E+04	4.7E+01	4.7E+02	NC
1.0E-01	1	1.0E-01	1.0E-01	0	98-82-8	Isopropylbenzene (Cumene)	1.6E+02	5.2E+02	4.0E+01	6.6E+02	NC
1.0E-02	1	1.0E-02	1.0E-02	0	103-65-1	n-Propylbenzene	1.4E+02	2.4E+02	3.7E+01	6.1E+01	NC
2.0E-01	1	2.0E-01	2.0E-01	0	57-55-6	Propylene glycol	1.0E+05	1.0E+05	7.3E+04	7.3E+05	NC
7.0E-01	1	7.0E-01	7.0E-01	0	111-35-3	Propylene glycol, monoethyl ether	4.3E+04	1.0E+05	2.6E+03	2.6E+04	NC
2.4E-01	1	2.4E-01	2.4E-01	0	107-99-2	Propylene glycol, monomethyl ether	4.3E+04	1.0E+05	2.1E+03	2.1E+04	NC
1.0E-03	1	1.0E-03	1.0E-03	0	75-56-9	Pursuit	1.9E+00	9.1E+00	5.2E-01	2.2E-01	CA
2.5E-01	1	2.5E-01	2.5E-01	0	81305-77-5	Pyridine	1.5E+04	1.0E+05	9.1E+02	9.1E+03	NC
2.5E-02	1	2.5E-02	2.5E-02	0	51630-58-1	Pyridine	1.5E+03	2.2E+04	9.1E+01	9.1E+02	NC
1.0E-03	1	1.0E-03	1.0E-03	0	110-68-1	Quinalphos	6.1E+01	8.8E+02	3.7E+00	3.6E+01	NC
5.0E-04	1	5.0E-04	5.0E-04	0	13593-03-8	Quinalphos	3.1E+01	4.4E+02	1.8E+00	1.8E+01	NC
1.2E+01	1	1.2E+01	1.2E+01	0	91-22-5	Quinoline	4.1E-02	2.1E-01	5.6E-04	5.6E-03	CA
1.1E-01	1	1.1E-01	1.1E-01	0	121-82-4	RDX (Cyclonite)	4.4E+00	2.2E+01	6.1E-02	6.1E-01	CA
5.0E-02	1	5.0E-02	5.0E-02	0	10453-86-8	Resmethrin	1.8E+03	2.6E+04	1.1E+02	1.1E+03	NC
4.0E-03	1	4.0E-03	4.0E-03	0	239-84-3	Romel	3.1E+03	4.4E+04	1.8E+02	1.8E+03	NC
2.5E-02	1	2.5E-02	2.5E-02	0	8379-4	Rotenone	2.4E+02	3.5E+03	1.5E+01	1.5E+02	NC
5.0E-03	1	5.0E-03	5.0E-03	0	78587-05-0	Savey	1.5E+03	2.2E+04	9.1E+01	9.1E+02	NC
5.0E-03	1	5.0E-03	5.0E-03	0	7783-00-8	Selenious Acid	3.1E+02	4.4E+03	1.8E+02	1.8E+02	NC
5.0E-03	1	5.0E-03	5.0E-03	0	7782-48-2	Selenium	3.9E+02	1.0E+04	1.8E+02	1.8E+02	NC
5.0E-03	1	5.0E-03	5.0E-03	0	630-10-4	Selenourea	3.1E+02	4.4E+03	1.8E+02	1.8E+02	NC
9.0E-02	1	9.0E-02	9.0E-02	0	74051-60-2	Saflaxidim	5.5E+03	7.9E+04	3.3E+02	3.3E+03	NC
5.0E-03	1	5.0E-03	5.0E-03	0	7440-22-4	Silver and compounds	3.9E+02	1.0E+04	1.8E+02	1.8E+02	NC
1.2E-01	1	1.2E-01	1.2E-01	0	122-34-9	Simazine	4.1E+00	2.1E+01	5.6E-02	5.6E-01	CA
4.0E-03	1	4.0E-03	4.0E-03	0	26820-22-8	Sodium azide	2.4E+02	3.5E+03	1.5E+01	1.5E+02	NC
3.0E-02	1	3.0E-02	3.0E-02	0	148-19-5	Sodium diethyldithiocarbamate	1.8E+00	9.1E+00	2.5E-02	2.5E-01	CA
2.0E-05	1	2.0E-05	2.0E-05	0	62-74-8	Sodium fluoracetate	1.2E+00	1.8E+01	7.3E-02	7.3E-01	NC
1.0E-03	1	1.0E-03	1.0E-03	0	13716-26-8	Sodium metavanadate	6.1E+01	8.8E+02	3.7E+00	3.6E+01	NC
6.0E-01	1	6.0E-01	6.0E-01	0	7440-24-8	Srionium, stable	4.7E+04	1.0E+05	2.2E+04	2.2E+04	NC
3.0E-04	1	3.0E-04	3.0E-04	0	57-24-9	Styrene	1.8E+01	1.0E+02	1.1E+00	1.1E+01	NC
2.0E-01	1	2.0E-01	2.0E-01	0	100-42-5	Syrene	1.7E+03	1.7E+03	1.1E+03	1.1E+03	NC
2.5E-02	1	2.5E-02	2.5E-02	0	98671-89-0	Syrene	1.5E+03	2.2E+04	9.1E+01	9.1E+02	NC
1.3E-02	1	1.3E-02	1.3E-02	0	1748-01-8	2,3,7,8-TCDD (dioxin)	3.9E-06	2.7E-05	4.5E-08	4.5E-07	CA
7.0E-02	1	7.0E-02	7.0E-02	0	34014-18-1	Tebuthiuron	4.3E+03	6.2E+04	2.6E+02	2.6E+03	NC
2.0E-02	1	2.0E-02	2.0E-02	0	3393-96-8	Temephos	1.2E+03	1.8E+04	7.3E+01	7.3E+02	NC
1.3E-02	1	1.3E-02	1.3E-02	0	5902-51-2	Terbacil	7.9E+02	1.8E+04	4.7E+01	4.7E+02	NC
2.5E-05	1	2.5E-05	2.5E-05	0	13071-79-9	Terbufos	1.5E+00	2.2E+01	9.1E-02	9.1E-01	NC
3.0E-04	1	3.0E-04	3.0E-04	0	888-50-0	Terbutyn	6.1E+01	8.8E+02	3.7E+00	3.6E+01	NC
2.0E-02	1	2.0E-02	2.0E-02	0	630-20-6	1,2,4,5-Tetrachlorobenzene	1.8E+01	2.6E+02	1.1E+00	1.1E+01	NC
3.0E-04	1	3.0E-04	3.0E-04	0	95-94-3	1,1,1,2-Tetrachloroethane	3.0E+00	7.0E+00	2.6E-01	4.3E-01	CA
2.0E-01	1	2.0E-01	2.0E-01	0	79-34-5	1,1,2,2-Tetrachloroethane	3.8E-01	9.0E-01	3.3E-02	5.5E-02	CA
5.2E-02	1	5.2E-02	5.2E-02	0	127-18-4	Tetrachloroethylene (PCE)	5.7E+00	1.9E+01	3.3E+00	1.1E+00	CA
3.0E-02	1	3.0E-02	3.0E-02	0	58-90-2	"CAL-Modified PRG" (PEA, 1994)	1.8E+03	2.6E+04	1.1E+02	1.1E+03	NC
2.4E-02	1	2.4E-02	2.4E-02	0	5216-25-1	2,3,4,6-Tetrachlorophenol	2.4E-02	1.2E-01	3.4E-04	3.4E-03	NC
3.0E-02	1	3.0E-02	3.0E-02	0	961-11-5	p.a.a.-Tetrachlorobenzene	2.0E+01	1.0E+02	2.8E-01	2.8E-00	CA
5.0E-04	1	5.0E-04	5.0E-04	0	3689-24-5	Tetrachlorophosphos	3.1E+01	4.4E+02	1.8E+00	1.8E+01	CA
7.0E-03	1	7.0E-03	7.0E-03	0	109-99-9	Tetraethylthiopyrophosphate	6.4E+01	3.2E+02	9.9E-01	8.8E+00	CA
7.0E-05	1	7.0E-05	7.0E-05	0	1314-32-5	Tetrahydrofuran	5.5E+00	1.4E+02	2.6E+00	2.6E+00	NC
9.0E-05	1	9.0E-05	9.0E-05	0	563-89-8	Thallium oxide	6.3E+00	1.6E+02	3.3E+00	3.3E+00	NC
8.0E-05	1	8.0E-05	8.0E-05	0	6533-73-9	Thallium acetate	6.3E+00	1.6E+02	3.3E+00	3.3E+00	NC
9.0E-05	1	9.0E-05	9.0E-05	0	7781-12-0	Thallium carbonate	6.3E+00	1.6E+02	3.3E+00	3.3E+00	NC
9.0E-05	1	9.0E-05	9.0E-05	0	10102-45-1	Thallium chloride	7.0E+00	1.8E+02	3.3E+00	3.3E+00	NC
9.0E-05	1	9.0E-05	9.0E-05	0	12039-52-0	Thallium nitrate	7.0E+00	1.8E+02	3.3E+00	3.3E+00	NC
8.0E-05	1	8.0E-05	8.0E-05	0	7446-16-5	Thallium selenite	6.3E+00	1.6E+02	3.3E+00	3.3E+00	NC
1.0E-02	1	1.0E-02	1.0E-02	0	24049-77-6	Thallium sulfate	6.1E+02	8.8E+03	3.7E+01	3.6E+02	NC
1.0E-02	1	1.0E-02	1.0E-02	0	7446-16-5	Thiobencarb	6.1E+02	8.8E+03	3.7E+01	3.6E+02	NC

Key: L=IRIS, N=ICEA, H=HEAST, X=WITHDRAWN, @=Other EPA DOCUMENTS, R=ROUTE EXTRAPOLATION, CA=CANCER PRG, NC=NONCANCER PRG, SSI=SOIL SATURATION, MAX=CEILING LIMIT, (where: NC < 100X CA) ** (where: NC < 10X CA)

FOR PLANNING PURPOSES

TOXICITY INFORMATION										CONTAMINANT										PRELIMINARY REMEDIATION GOALS (PRGs)										SOIL SCREENING LEVELS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
SFo 1/(mg/kg-d)	RfD ^a 1/(mg/kg-d)	SFI 1/(mg/kg-d)	RfDI 1/(mg/kg-d)	V. skin O. abs. C. soils	CAS No.	Thiocyanate	Thiolanox	Thiophanate-methyl	Thiram	Tin (inorganic, see tributyltin oxide for organic tin)	Toluene	Toluene-2,4-diamine	Toluene-2,5-diamine	Toluene-2,6-diamine	p-Toluidine	Oxaphene	Tralometrin	Triallate	Triasulfuron	1,2,4-Tribromobenzene	Tributyltin oxide (TBTO)	2,4,6-Trichloroaniline	2,4,6-Trichloroaniline hydrochloride	1,2,4-Trichlorobenzene	1,1,1-Trichloroethane	1,1,2-Trichloroethane	Trichloroethylene (TCE)	Trichlorofluoromethane	2,4,5-Trichlorophenol	2,4,6-Trichlorophenol	2,4,5-Trichlorophenoxyacetic Acid	2-(2,4,5-Trichlorophenoxy) propionic acid	1,1,2-Trichloropropane	1,2,3-Trichloropropane	1,2,3-Trichloropropene	1,1,2-Trichloro-1,2,2-trifluoroethane	Triphane	Triethylamine	Trifluralin	1,2,4-Trimethylbenzene	1,3,5-Trimethylbenzene	Trimethyl phosphate	1,3,5-Trinitrobenzene	Trinitrophenyl/methylnitramine	2,4,6-Trinitrotoluene	Vanadium	Vanadium pentoxide	Vanadium sulfate	Vernam	Vinclozolin	Vinyl acetate	Vinyl bromide (bromoethene)	Vinyl chloride	Warfarin	Xylenes	Zinc	Zinc phosphide	Zineb																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
1.0E-01	1.0E-01	n	1.0E-01	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
 REGION IX
 75 Hawthorne Street
 San Francisco, CA 94105

October 1, 1999

Subject: Region 9 Preliminary Remediation Goals (PRGs) 1999

From: Stanford J. Smucker, Ph.D.
 Regional Toxicologist (SFD-8-B)
 Technical Support Team

To: PRG Table Mailing List

Please find the annual update to the Region 9 PRG (Preliminary Remediation Goals) table. Risk-based PRGs presented in the "lookup" table are useful tools for evaluating and cleaning up contaminated sites. They are being used to streamline and standardize all stages of the risk decision-making process. If you are not currently on the PRG table mailing list but would like to be, please call Lynn Trujillo (415.744.2419) or email her (Trujillo.Dianna@epamail.epa.gov) and leave your name, address, and phone number.

EPA Region 9 has established a homepage for the PRGs on the World Wide Web which you can find at <http://www.epa.gov/region09/waste/sfund/prg/>. The PRG homepage presents additional information not available in the printed tables that are sent out to folks; including pathway-specific screening concentrations, non-cancer PRGs for carcinogenic substances, and physical-chemical information for volatile organic compounds (VOCs). This information may be viewed or downloaded at our website.

Region 9 risk-based PRGs are "evergreen" and have evolved as new methodologies and parameters have been developed. Changes to individual PRGs that have occurred from the 1998 table reflect either updates in toxicity information or a reclassification of a chemical's status as a VOC. These chemical-specific changes are identified by boldface type in the table. In addition, a more global change in the PRG numeric values reflects new exposure guidelines presented in "Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim Guidance" (USEPA 1999a, see Section 4.3).

Chemicals for which toxicity values have been revised or added include: **acetonitrile, aluminum, antimony trioxide, chlordane, chlorobenzene, chloroethane, chloroform, chloromethane, chromium VI, dichlorobenzene isomers, ethyl chloride, manganese, nitroglycerin, 4-nitrophenol, PCBs, 1,1,2,2-tetrachloroethane, and tetrahydrofuran**. Updates to EPA toxicity values were obtained from IRIS and the National Center for Environmental Assessment (NCEA) through August 1999.

Chemicals for which the VOC status has changed in an effort to reconcile differences among the regions include: **chloronitrobenzene isomers, cyanogen and its salts, methylcyclohexane,**

methylene bromide, and the nitrotoluene isomers. The criteria for VOC status are taken from RAGS Part B. However, three "borderline chemicals" (**dibromochloromethane, 1,2-dibromochloropropane, and pyrene**) that do not strictly meet the RAGS criteria of volatility have also been included based upon discussions with other state and federal agencies and after a consideration of vapor pressure characteristics etc.

Before relying on any number in the table, it is recommended that the user verify the numbers with an agency toxicologist or risk assessor because the toxicity / exposure information in the table may contain errors or default assumptions that need to be refined based on further evaluation. If you find an error please send me a note via email at smucker.stan@epamail.epa.gov or fax at 415.744.1916.

DISCLAIMER

Preliminary remediation goals (PRGs) focus on common exposure pathways and may not consider all exposure pathways encountered at CERCLA / RCRA sites (Exhibit 1-1). PRGs do not consider impact to groundwater or address ecological concerns. PRGs are specifically not intended as a (1) stand-alone decision-making tool, (2) as a substitute for EPA guidance for preparing baseline risk assessments, or (3) a rule to determine if a waste is hazardous under RCRA.

The guidance set out in this document is not final Agency action. It is not intended, nor can it be relied upon to create any rights enforceable by any party in litigation with the United States. EPA officials may decide to follow the guidance provided herein, or act at variance with the guidance, based on an analysis of specific circumstances. The Agency also reserves the right to change this guidance at any time without public notice.

1.0 INTRODUCTION

Region 9 Preliminary Remediation Goals (PRGs) are risk-based tools for evaluating and cleaning up contaminated sites. They are being used to streamline and standardize all stages of the risk decision-making process.

The Region 9 PRG table combines current EPA toxicity values with "standard" exposure factors to estimate contaminant concentrations in environmental media (soil, air, and water) that are considered protective of humans, including sensitive groups, over a lifetime. Chemical concentrations above these levels would not automatically designate a site as "dirty" or trigger a response action. However, exceeding a PRG suggests that further evaluation of the potential risks that may be posed by site contaminants is appropriate. Further evaluation may include additional sampling, consideration of ambient levels in the environment, or a reassessment of the assumptions contained in these screening-level estimates (e.g. appropriateness of route-to-route extrapolations, appropriateness of using chronic toxicity values to evaluate childhood exposures, appropriateness of generic exposure factors for a specific site etc.).

The PRG concentrations presented in the table can be used to screen pollutants in environmental media, trigger further investigation, and provide an initial cleanup goal if applicable. When

considering PRGs as preliminary goals, residential concentrations should be used for maximum beneficial uses of a property. Industrial concentrations are included in the table as an alternative cleanup goal for soils. In general, it is not recommended that industrial PRGs be used for screening sites unless they are used in conjunction with residential values.

Before applying PRGs as screening tools or initial goals, the user of the table should consider whether the exposure pathways and exposure scenarios at the site are fully accounted for in the PRG calculation. Region 9 PRG concentrations are based on exposure pathways for which generally accepted methods, models, and assumptions have been developed (i.e. ingestion, dermal contact, and inhalation) for specific land-use conditions and do not consider impact to groundwater or ecological receptors (see Developing a Conceptual Site Model below).

EXHIBIT 1-1
TYPICAL EXPOSURE PATHWAYS BY MEDIUM
FOR RESIDENTIAL AND INDUSTRIAL LAND USES^a

EXPOSURE PATHWAYS, ASSUMING:		
MEDIUM	RESIDENTIAL LAND USE	INDUSTRIAL LAND USE
Ground Water	<i>Ingestion from drinking</i>	Ingestion from drinking
	<i>Inhalation of volatiles</i>	Inhalation of volatiles
	Dermal absorption from bathing	Dermal absorption
Surface Water	<i>Ingestion from drinking</i>	Ingestion from drinking
	<i>Inhalation of volatiles</i>	Inhalation of volatiles
	Dermal absorption from bathing	Dermal absorption
	Ingestion during swimming	
	Ingestion of contaminated fish	
Soil	<i>Ingestion</i>	<i>Ingestion</i>
	<i>Inhalation of particulates</i>	<i>Inhalation of particulates</i>
	<i>Inhalation of volatiles</i>	<i>Inhalation of volatiles</i>
	Exposure to indoor air from soil gas	Exposure to indoor air from soil gas
	Exposure to ground water contaminated by soil leachate	Exposure to ground water contaminated by soil leachate
	Ingestion via plant, meat, or dairy products	Inhalation of particulates from trucks and heavy equipment
	<i>Dermal absorption</i>	<i>Dermal absorption</i>

Footnote:

^aExposure pathways considered in the PRG calculations are indicated in boldface italics.

2.0 READING THE PRG TABLE

2.1 General Considerations

With the exceptions described below, PRGs are chemical concentrations that correspond to fixed levels of risk (i.e. either a one-in-one million [10^{-6}] cancer risk or a noncarcinogenic hazard quotient of 1) in soil, air, and water. In most cases, where a substance causes both cancer and noncancer (systemic) effects, the 10^{-6} cancer risk will result in a more stringent criteria and consequently this value is presented in the hard copy of the table. PRG concentrations that equate to a 10^{-6} cancer risk are indicated by "ca". PRG concentrations that equate to a hazard quotient of 1 for noncarcinogenic concerns are indicated by "nc".

If the risk-based concentrations are to be used for site screening, it is recommended that both cancer and noncancer-based PRGs be used. Both carcinogenic and noncarcinogenic values may be obtained at the Region 9 PRG homepage at:

<http://www.epa.gov/region09/waste/sfund/prg/>

It has come to my attention that some users have been multiplying the cancer PRG concentrations by 10 or 100 to set "action levels" for triggering remediation or to set less stringent cleanup levels for a specific site after considering non-risk-based factors such as ambient levels, detection limits, or technological feasibility. This risk management practice recognizes that there may be a range of values that may be "acceptable" for carcinogenic risk (EPA's risk management range is one-in-a-million [10^{-6}] to one-in-ten thousand [10^{-4}]). However, this practice could lead one to overlook serious noncancer health threats and it is strongly recommended that the user consult with a toxicologist or regional risk assessor before doing this. For carcinogens, I have indicated by asterisk ("ca*") in the PRG table where the noncancer PRGs would be exceeded if the cancer value that is displayed is multiplied by 100. Two stars ("ca**") indicate that the noncancer values would be exceeded if the cancer PRG were multiplied by 10. There is no range of "acceptable" noncarcinogenic "risk" so that under no circumstances should noncancer PRGs be multiplied by 10 or 100, when setting final cleanup criteria.

In general, PRG concentrations in the table are risk-based but for soil there are two important exceptions: (1) for several volatile chemicals, PRGs are based on the soil saturation equation ("sat") and (2) for relatively less toxic inorganic and semivolatile contaminants, a non-risk based "ceiling limit" concentration is given as 10^{-5} mg/kg ("max").

Also included in the PRG table are California EPA PRGs ("CAL-Modified PRGs") for specific chemicals where CAL-EPA screening values may be "significantly" more restrictive than the federal values; and, soil screening levels (SSLs) for protection of groundwater (see Section 2.3 below).

2.2 Toxicity Values

Hierarchy of Toxicity Values

EPA toxicity values, known as noncarcinogenic reference doses (RfD) and carcinogenic slope

factors (SF) were obtained from IRIS, NCEA (formerly ECAO) through August 1999, and HEAST. The priority among sources of toxicological constants has changed since the last iteration of the table because the HEAST tables are no longer being updated. Therefore, the revised order of preference is as follows: (1) IRIS (indicated by "i"), (2) NCEA ("n"), (3) HEAST ("h"), (4) withdrawn from IRIS or HEAST and under review ("x") or obtained from other EPA documents ("o").

Inhalation Conversion Factors

As of January 1991, IRIS and NCEA databases no longer present RfDs or SFs for the inhalation route. These criteria have been replaced with reference concentrations (RfC) for noncarcinogenic effects and unit risk factors (URF) for carcinogenic effects. However, for purposes of estimating risk and calculating risk-based concentrations, inhalation reference doses (RfDi) and inhalation slope factors (SF_i) are preferred. This is not a problem for most chemicals because the inhalation toxicity criteria are easily converted. To calculate an RfDi from an RfC, the following equation and assumptions may be used for most chemicals:

$$\text{RfDi} \frac{\text{mg}}{(\text{kg} \cdot \text{day})} = \text{RfC} (\text{mg} / \text{m}^3) \times \frac{20\text{m}^3}{\text{day}} \times \frac{1}{70\text{kg}}$$

Likewise, to calculate an SF_i from an inhalation URF, the following equation and assumptions may be used:

$$\text{SF}_i \frac{(\text{kg} \cdot \text{day})}{(\text{mg})} = \text{URF} (\text{m}^3 / \text{ug}) \times \frac{\text{day}}{20\text{m}^3} \times 70\text{kg} \times \frac{10^3 \text{ ug}}{\text{mg}}$$

Substances with New Toxicity Values

To help users rapidly identify substances with new toxicity values, these chemicals are printed in boldface type. This issue of the PRG table contains new or revised toxicity values for **acetonitrile, aluminum, antimony trioxide, chlordane, chlorobenzene, chloroethane, chloroform, chloromethane, chromium VI, dichlorobenzene isomers, ethyl chloride, manganese, nitroglycerin, 4-nitrophenol, PCBs, 1,1,2,2-tetrachloroethane, and tetrahydrofuran.**

Route-to-Route Methods

Route-to-route extrapolations ("r") were frequently used when there were no toxicity values available for a given route of exposure. Oral cancer slope factors ("SF_o") and reference doses ("RfD_o") were used for both oral and inhaled exposures for organic compounds lacking inhalation values. Inhalation slope factors ("SF_i") and inhalation reference doses ("RfD_i") were used for both inhaled and oral exposures for organic compounds lacking oral values. Route

extrapolations were not performed for inorganics due to portal of entry effects and known differences in absorption efficiency for the two routes of exposure.

An additional route extrapolation is the use of oral toxicity values for evaluating dermal exposures. For many chemicals, a scientifically defensible data base does not exist for making an adjustment of an oral slope factor/RfD to estimate a dermal toxicity value. Based on the current guidance (USEPA 1999a), the only chemical for which an adjustment is recommended is cadmium. An oral absorption efficiency of 5% is assumed for cadmium which leads to an estimated dermal reference dose (RfDd) of $2.5E-05$. Please note that the 1999 PRG calculations for cadmium are based on this adjustment.

Although route-to-route methods are a useful screening procedure, the appropriateness of these default assumptions for specific contaminants should be verified by a toxicologist or regional risk assessor. Please note that whenever route-extrapolated values are used to calculate risk-based PRGs, additional uncertainties are introduced in the calculation.

2.3 Soil Screening Levels

Generic, soil screening levels (SSLs) for the protection of groundwater have been included in the PRG table for 100 of the most common contaminants at Superfund sites. Generic SSLs are derived using default values in standardized equations presented in *Soil Screening Guidance* (available from NTIS as document numbers PB96-963502 and PB96-963505 or EPA/540/R-95/128 and EPA/540/R-96/018).

The SSLs were developed using a default dilution-attenuation factor (DAF) of 20 to account for natural processes that reduce contaminant concentrations in the subsurface. Also included are generic SSLs that assume no dilution or attenuation between the source and the receptor well (i.e., a DAF of 1). These values can be used at sites where little or no dilution or attenuation of soil leachate concentrations is expected at a site (e.g., sites with shallow water tables, fractured media, karst topography, or source size greater than 30 acres).

In general, if an SSL is not exceeded for the migration to groundwater pathway, the user may eliminate this pathway from further investigation.

2.4 Miscellaneous

Volatile organic compounds (VOCs) are indicated by "1" in the VOC column of the table and in general, are defined as those chemicals having a Henry's Law constant greater than 10^{-5} (atm-m³/mol) and a molecular weight less than 200 g/mole). Three borderline chemicals (dibromochloromethane, 1,2-dibromochloropropane, and pyrene) which do not strictly meet these criteria of volatility have also been included based upon discussions with other state and federal agencies and after a consideration of vapor pressure characteristics etc. Volatile organic chemicals are evaluated for potential volatilization from soil/water to air using volatilization factors (see Section 4.1).

Chemical-specific dermal absorption values for contaminants in soil and dust are presented for arsenic, cadmium, chlordane, 2,4-D, DDT, lindane, TCDD, PAHs, PCBs, and pentachlorophenols as recommended in the "Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim Guidance" (USEPA 1999a). Otherwise, default skin absorption fractions are assumed to

be 0.10 for nonvolatile organics. Please note that previous defaults of 0.01 and 0.10 for inorganics and VOCs respectively, have been withdrawn per new guidance.

3.0 USING THE PRG TABLE

The decision to use PRGs at a site will be driven by the potential benefits of having generic risk-based concentrations in the absence of site-specific risk assessments. The original intended use of PRGs was to provide initial cleanup goals for individual chemicals given specific medium and land-use combinations (see RAGS Part B, 1991), however risk-based concentrations have several applications. They can also be used for:

- Setting health-based detection limits for chemicals of potential concern
- Screening sites to determine whether further evaluation is appropriate
- Calculating cumulative risks associated with multiple contaminants

A few basic procedures are recommended for using PRGs properly. These are briefly described below. Potential problems with the use of PRGs are also identified.

3.1 Developing a Conceptual Site Model

The primary condition for use of PRGs is that exposure pathways of concern and conditions at the site match those taken into account by the PRG framework. Thus, it is always necessary to develop a conceptual site model (CSM) to identify likely contaminant source areas, exposure pathways, and potential receptors. This information can be used to determine the applicability of PRGs at the site and the need for additional information. For those pathways not covered by PRGs, a risk assessment specific to these additional pathways may be necessary. Nonetheless, the PRG lookup values will still be useful in such situations for focusing further investigative efforts on the exposure pathways not addressed.

To develop a site-specific CSM, perform an extensive records search and compile existing data (e.g. available site sampling data, historical records, aerial photographs, and hydrogeologic information). Once this information is obtained, CSM worksheets such as those provided in ASTM's *Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites* (1995) can be used to tailor the generic worksheet model to a site-specific CSM. The final CSM diagram represents linkages among contaminant sources, release mechanisms, exposure pathways and routes and receptors. It summarizes our understanding of the contamination problem.

As a final check, the CSM should answer the following questions:

- Are there potential ecological concerns?
- Is there potential for land use other than those covered by the PRGs (that is, residential and industrial)?
- Are there other likely human exposure pathways that were not considered in development

of the PRGs (e.g. impact to groundwater, local fish consumption, raising beef, dairy, or other livestock)?

- Are there unusual site conditions (e.g. large areas of contamination, high fugitive dust levels, potential for indoor air contamination)?

If any of these four conditions exist, the PRG may need to be adjusted to reflect this new information. Suggested references for evaluating pathways not currently evaluated by Region 9 PRG's are presented in Exhibit 3-1.

EXHIBIT 3-1
SUGGESTED READINGS FOR EVALUATING EXPOSURE
PATHWAYS NOT CURRENTLY ADDRESSED BY REGION 9 PRGs

EXPOSURE PATHWAY	REFERENCE
Migration of contaminants to an underlying potable aquifer	<i>Soil Screening Guidance</i> (USEPA 1996a,b), <i>Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites</i> (ASTM 1995)
Ingestion via plant uptake	<i>Soil Screening Guidance</i> (USEPA 1996a,b)
Ingestion via meat, dairy products, human milk	<i>Estimating Exposure to Dioxin-Like Compounds</i> (USEPA 1994a)
Inhalation of volatiles that have migrated into basements	<i>User's Guide for Johnson and Ettinger (1991) Model for Subsurface Vapor Intrusion into Buildings</i> (USEPA 1997a)
Ecological pathways	<i>Ecological Risk Assessment: Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments</i> , (USEPA 1997b), <i>Guidance for Ecological Risk Assessment at Hazardous Waste Sites and Permitted Facilities</i> (CAL-EPA 1996)

3.2 Background Levels Evaluation

A necessary step in determining the usefulness of Region 9 PRGs is the consideration of background contaminant concentrations. EPA may be concerned with two types of background at sites: naturally occurring and anthropogenic. Natural background is usually limited to metals whereas anthropogenic (i.e. human-made) "background" includes both organic and inorganic contaminants. Before embarking on an extensive sampling and analysis program to determine local background concentrations in the area, one should first compile existing data on the subject. Far too often there is pertinent information in the literature that gets ignored, resulting in needless expenditures of time and money.

Generally EPA does not clean up below natural background. In some cases, the predictive risk-based models generate PRG levels that lie within or even below typical background. If natural background concentrations are higher than the risk-based PRGs, an adjustment of the PRG is probably needed. Exhibit 3-2 presents summary statistics for selected elements in soils that have background levels that may exceed risk-based PRGs. An illustrative example of this is naturally occurring arsenic in soils which frequently is higher than the risk-based concentration set at a one-in-one-million cancer risk (the PRG for residential soils is 0.39 mg/kg). After considering background concentrations in a local area, EPA Region 9 has at times used the non-cancer PRG (22 mg/kg) to evaluate sites recognizing that this value tends to be above background levels yet still falls within the range of soil concentrations (0.39-39 mg/kg) that equates to EPA's "acceptable" cancer risk range of 10E-6 to 10E-4.

Where anthropogenic "background" levels exceed PRGs and EPA has determined that a response action is necessary and feasible, EPA's goal will be to develop a comprehensive response to the widespread contamination. This will often require coordination with different authorities that have jurisdiction over the sources of contamination in the area.

EXHIBIT 3-2
BACKGROUND CONCENTRATIONS OF SELECTED ELEMENTS IN SOILS

TRACE ELEMENT	U.S. STUDY DATA ¹			CALIFORNIA DATA ²		
	Range	GeoMean	ArMean	Range	GeoMean	ArMean
Arsenic	<1-97	5.2 mg/kg	7.2 mg/kg	0.59-11	2.75 mg/kg	3.54 mg/kg
Beryllium	<1-15	0.63 "	0.92 "	0.10-2.7	1.14 "	1.28 "
Cadmium	<1-10	--	<1	0.05-1.7	0.26	0.36
Chromium	1-2000	37	54	23-1579	76.25	122.08
Nickel	<5-700	13	19	9.0-509	35.75	56.60

¹Shacklette and Hansford, "Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States", USGS Professional Paper 1270, 1984.

²Bradford et. al, "Background Concentrations of Trace and Major Elements in California Soils", Kearney Foundation Special Report, UC-Riverside and CAL-EPA DISC, March 1996.

3.3 Screening Sites with Multiple Pollutants

A suggested stepwise approach for PRG-screening of sites with multiple pollutants is as follows:

- Perform an extensive records search and compile existing data.
- Identify site contaminants in the PRG table. Record the PRG concentrations for various media and note whether PRG is based on cancer risk (indicated by "ca") or noncancer hazard (indicated by "nc"). Segregate cancer PRGs from non-cancer PRGs and exclude (but don't eliminate) non-risk based PRGs ("sat" or "max").

- For cancer risk estimates, take the site-specific concentration (maximum or 95 UCL) and divide by the PRG concentrations that are designated for cancer evaluation ("ca"). Multiply this ratio by 10^{-6} to estimate chemical-specific risk for a reasonable maximum exposure (RME). For multiple pollutants, simply add the risk for each chemical:

$$Risk = [(\frac{conc_x}{PRG_x}) + (\frac{conc_y}{PRG_y}) + (\frac{conc_z}{PRG_z})] \times 10^{-6}$$

- For non-cancer hazard estimates. Divide the concentration term by its respective non-cancer PRG designated as "nc" and sum the ratios for multiple contaminants. The cumulative ratio represents a non-carcinogenic hazard index (HI). A hazard index of 1 or less is generally considered "safe". A ratio greater than 1 suggests further evaluation. **[Note that carcinogens may also have an associated non-cancer PRG that is not listed in the printed copy of the table sent to folks on the mailing list. To obtain these values, the user should view or download the PRG table at our website and display the appropriate sections.]**

$$Hazard\ Index = [(\frac{conc_x}{PRG_x}) + (\frac{conc_y}{PRG_y}) + (\frac{conc_z}{PRG_z})]$$

For more information on screening site risks, the reader should contact EPA Region 9's Technical Support Team.

3.4 Potential Problems

As with any risk-based tool, the potential exists for misapplication. In most cases the root cause will be a lack of understanding of the intended use of Region 9 PRGs. In order to prevent misuse of PRGs, the following should be avoided:

- Applying PRGs to a site without adequately developing a conceptual site model that identifies relevant exposure pathways and exposure scenarios,
- Not considering background concentrations when choosing PRGs as cleanup goals,
- Use of PRGs as cleanup levels without the nine-criteria analysis specified in the National Contingency Plan (or, comparable analysis for programs outside of Superfund),
- Use of PRGs as cleanup levels without verifying numbers with a toxicologist or regional risk assessor,
- Use of antiquated PRG tables that have been superseded by more recent publications,
- Not considering the effects of additivity when screening multiple chemicals, and
- Adjusting PRGs upward by factors of 10 or 100 without consulting a toxicologist or regional risk assessor.

4.0 TECHNICAL SUPPORT DOCUMENTATION

Region 9 PRGs consider human exposure hazards to chemicals from contact with contaminated soils, air, and water. The emphasis of the PRG equations and technical discussion are aimed at developing screening criteria for soils, since this is an area where few standards exist. For air and water, additional reference concentrations or standards are available for many chemicals (e.g. MCLs, non-zero MCLGs, AWQC, and NAAQS) and consequently the discussion of these media are brief.

4.1 Soils - Direct Ingestion

Calculation of risk-based PRGs for direct ingestion of soil is based on methods presented in RAGS HHEM, Part B (USEPA 1991a) and *Soil Screening Guidance* (USEPA 1996a,b). Briefly, these methods backcalculate a soil concentration level from a target risk (for carcinogens) or hazard quotient (for noncarcinogens).

A number of studies have shown that inadvertent ingestion of soil is common among children 6 years old and younger (Calabrese et al. 1989, Davis et al. 1990, Van Wijnen et al. 1990). To take into account the higher soil intake rate for children, two different approaches are used to estimate PRGs, depending on whether the adverse health effect is cancer or some effect other than cancer.

For carcinogens, the method for calculating PRGs uses an age-adjusted soil ingestion factor that

takes into account the difference in daily soil ingestion rates, body weights, and exposure duration for children from 1 to 6 years old and others from 7 to 31 years old. This health-protective approach is chosen to take into account the higher daily rates of soil ingestion in children as well as the longer duration of exposure that is anticipated for a long-term resident. For more on this method, see USEPA RAGs Part B (1991a).

For noncarcinogenic concerns, the more protective method of calculating a soil PRG is to evaluate childhood exposures separately from adult exposures. In other words, an age-adjustment factor is not applied as was done for carcinogens. This approach is considered conservative because it combines the higher 6-year exposure for children with chronic toxicity criteria. In their analysis of the method, the Science Advisory Board (SAB) indicated that, for most chemicals, the approach may be overly protective. However, they noted that there are specific instances when the chronic RfD may be based on endpoints of toxicity that are specific to children (e.g. fluoride and nitrates) or when the dose-response is steep (i.e., the dosage difference between the no-observed-adverse-effects level [NOAEL] and an adverse effects level is small). Thus, for the purposes of screening, EPA Region 9 has adopted this approach for calculating soil PRGs for noncarcinogenic health concerns.

4.2 Soils - Vapor and Particulate Inhalation

Agency toxicity criteria indicate that risks from exposure to some chemicals via inhalation far outweigh the risk via ingestion; therefore soil PRGs have been designed to address this pathway as well. The models used to calculate PRGs for inhalation of volatiles/particulates are updates of risk assessment methods presented in RAGS Part B (USEPA 1991a) and are identical to the *Soil Screening Guidance: User's Guide and Technical Background Document* (USEPA 1996a,b).

To address the soil-to-air pathways the PRG calculations incorporate volatilization factors (VF_s) for volatile contaminants and particulate emission factors (PEF) for nonvolatile contaminants. These factors relate soil contaminant concentrations to air contaminant concentrations that may be inhaled on-site. The VF_s and PEF equations can be broken into two separate models: an emission model to estimate emissions of the contaminant from the soil and a dispersion model to simulate the dispersion of the contaminant in the atmosphere.

It should be noted that the box model in RAGS Part B has been replaced with a dispersion term (Q/C) derived from a modeling exercise using meteorological data from 29 locations across the United States because the box model may not be applicable to a broad range of site types and meteorology and does not utilize state-of-the-art techniques developed for regulatory dispersion modeling. The dispersion model for both volatiles and particulates is the AREA-ST, an updated version of the Office of Air Quality Planning and Standards, Industrial Source Complex Model, ISC2. However, different Q/C terms are used in the VF and PEF equations. Los Angeles was selected as the 90th percentile data set for volatiles and Minneapolis was selected as the 90th percentile data set for fugitive dusts (USEPA 1996 a,b). A default source size of 0.5 acres was chosen for the PRG calculations. This is consistent with the default exposure area over which Region 9 typically averages contaminant concentrations in soils. If unusual site conditions exist such that the area source is substantially larger than the default source size assumed here, an alternative Q/C could be applied (see USEPA 1996a,b).

Volatilization Factor for Soils

Volatile chemicals, defined as those chemicals having a Henry's Law constant greater than 10^{-5} (atm-m³/mol) and a molecular weight less than 200 g/mole, were screened for inhalation exposures using a volatilization factor for soils (VF_s). Please note that VF_s's are available at our website.

The emission terms used in the VF_s are chemical-specific and were calculated from physical-chemical information obtained from several sources. The priority of these sources were as follows: *Soil Screening Guidance* (USEPA 1996a,b), *Superfund Chemical Data Matrix* (USEPA 1996c), *Fate and Exposure Data* (Howard 1991), *Subsurface Contamination Reference Guide* (EPA 1990a), and *Superfund Exposure Assessment Manual* (SEAM, EPA 1988). In those cases where Diffusivity Coefficients (Di) were not provided in existing literature, Di's were calculated using Fuller's Method described in SEAM. A surrogate term was required for some chemicals that lacked physico-chemical information. In these cases, a proxy chemical of similar structure was used that may over- or under-estimate the PRG for soils.

Equation 4-9 forms the basis for deriving generic soil PRGs for the inhalation pathway. The following parameters in the standardized equation can be replaced with specific site data to develop a simple site-specific PRG

- Source area
- Average soil moisture content
- Average fraction organic carbon content
- Dry soil bulk density

The basic principle of the VF_s model (Henry's law) is applicable only if the soil contaminant concentration is at or below soil saturation "sat". Above the soil saturation limit, the model cannot predict an accurate VF-based PRG. How these particular cases are handled, depends on whether the contaminant is liquid or solid at ambient soil temperatures (see Section 4.5)

Particulate Emission Factor for Soils

Inhalation of chemicals adsorbed to respirable particles (PM₁₀) were assessed using a default PEF equal to 1.316×10^9 m³/kg that relates the contaminant concentration in soil with the concentration of respirable particles in the air due to fugitive dust emissions from contaminated soils. The generic PEF was derived using default values in Equation 4-11, which corresponds to a receptor point concentration of approximately 0.76 ug/m³. The relationship is derived by Cowherd (1985) for a rapid assessment procedure applicable to a typical hazardous waste site where the surface contamination provides a relatively continuous and constant potential for emission over an extended period of time (e.g. years). This represents an annual average emission rate based on wind erosion that should be compared with chronic health criteria; it is not appropriate for evaluating the potential for more acute exposures.

The impact of the PEF on the resultant PRG concentration (that combines soil exposure pathways for ingestion, skin contact, and inhalation) can be assessed by accessing the Region 9 PRG website and viewing the pathway-specific soil concentrations. Equation 4-11 forms the basis for deriving a generic PEF for the inhalation pathway. For more details regarding specific parameters used in the PEF model, the reader is referred to *Soil Screening Guidance: Technical*

Note: the generic PEF evaluates windborne emissions and does not consider dust emissions from traffic or other forms of mechanical disturbance that could lead to greater emissions than assumed here.

4.3 Soils - Dermal Exposure

Dermal Contact Assumptions

Since the 1998 PRG table was issued, exposure factors for dermal contact with soil have changed in a few cases (USEPA 1999a). Recommended RME (reasonable maximum exposure) defaults for adult workers' skin surface areas ($3300 \text{ cm}^2/\text{day}$) and soil adherence factors ($0.2 \text{ mg}/\text{cm}^2$) now differ from the defaults recommended for adult residents ($5700 \text{ cm}^2/\text{day}$, $0.07 \text{ mg}/\text{cm}^2$) as noted in Exhibit 4-1. This is due to differences in the range of activities experienced by workers versus residents.

Dermal Absorption

Chemical-specific skin absorption values recommended by the Superfund Dermal Workgroup were applied when available. Chemical-specific values are included for the following chemicals: arsenic, cadmium, chlordane, 2,4-D, DDT, lindane, TCDD, PAHs, PCBs, and pentachlorophenols.

The recently issued "Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim Guidance" (USEPA 1999a) recommends a default dermal absorption factor for semivolatile organic compounds of 10% as a screening method for the majority of SVOCs without dermal absorption factors. Default dermal absorption values for other chemicals (VOCs and inorganics) are not recommended in the new guidance. Therefore, the assumption of 1% for inorganics and 10% for volatiles is no longer included in the Region 9 PRG table. This change has minimal impact on the final risk-based calculations because human exposure to VOCs and inorganics in soils is generally driven by other pathways of exposure.

4.4 Soils - Migration to Groundwater

The methodology for calculating SSLs for the migration to groundwater was developed to identify chemical concentrations in soil that have the potential to contaminate groundwater. Migration of contaminants from soil to groundwater can be envisioned as a two-stage process: (1) release of contaminant in soil leachate and (2) transport of the contaminant through the underlying soil and aquifer to a receptor well. The SSL methodology considers both of these fate and transport mechanisms.

SSLs are backcalculated from acceptable ground water concentrations (i.e. nonzero MCLGs, MCLs, or risk-based PRGs). First, the acceptable groundwater concentration is multiplied by a dilution factor to obtain a target leachate concentration. For example, if the dilution factor is 10 and the acceptable ground water concentration is $0.05 \text{ mg}/\text{L}$, the target soil leachate concentration would be $0.5 \text{ mg}/\text{L}$. The partition equation (presented in the *Soil Screening Guidance* document)

is then used to calculate the total soil concentration (i.e. SSL) corresponding to this soil leachate concentration.

The SSL methodology was designed for use during the early stages of a site evaluation when information about subsurface conditions may be limited. Because of this constraint, the methodology is based on conservative, simplifying assumptions about the release and transport of contaminants in the subsurface. For more on SSLs, and how to calculate site-specific SSLs versus generic SSLs presented in the PRG table, the reader is referred to the *Soil Screening Guidance* document (USEPA 1996a,b).

4.5 Soil Saturation Limit

The soil saturation concentration "sat" corresponds to the contaminant concentration in soil at which the absorptive limits of the soil particles, the solubility limits of the soil pore water, and saturation of soil pore air have been reached. Above this concentration, the soil contaminant may be present in free phase, i.e., nonaqueous phase liquids (NAPLs) for contaminants that are liquid at ambient soil temperatures and pure solid phases for compounds that are solid at ambient soil temperatures.

Equation 4-10 is used to calculate "sat" for each volatile contaminant. As an update to RAGS HHEM, Part B (USEPA 1991a), this equation takes into account the amount of contaminant that is in the vapor phase in soil in addition to the amount dissolved in the soil's pore water and sorbed to soil particles.

Chemical-specific "sat" concentrations must be compared with each VF-based PRG because a basic principle of the PRG volatilization model is not applicable when free-phase contaminants are present. How these cases are handled depends on whether the contaminant is liquid or solid at ambient temperatures. Liquid contaminants that have a VF-based PRG that exceeds the "sat" concentration are set equal to "sat" whereas for solids (e.g., PAHs), soil screening decisions are based on the appropriate PRGs for other pathways of concern at the site (e.g., ingestion and dermal contact).

4.6 Ground Water/Surface Water - Ingestion and Inhalation

Calculation of PRGs for ingestion and inhalation of contaminants in domestic water is based on the methodology presented in RAGS HHEM, Part B (USEPA 1991a). Ingestion of drinking water is an appropriate pathway for all chemicals. For the purposes of this guidance, however, inhalation of volatile chemicals from water is considered routinely only for chemicals with a Henry's Law constant of 1×10^{-5} atm-m³/mole or greater and with a molecular weight of less than 200 g/mole.

For volatile chemicals, an upperbound volatilization constant (VF_w) is used that is based on all uses of household water (e.g. showering, laundering, and dish washing). Certain assumptions were made. For example, it is assumed that the volume of water used in a residence for a family of four is 720 L/day, the volume of the dwelling is 150,000 L and the air exchange rate is 0.25 air changes/hour (Andelman in RAGS Part B). Furthermore, it is assumed that the average transfer efficiency weighted by water use is 50 percent (i.e. half of the concentration of each chemical in water will be transferred into air by all water uses). Note: the range of transfer efficiencies extends from 30% for toilets to 90% for dishwashers.

4.7 Default Exposure Factors

Default exposure factors were obtained primarily from RAGS Supplemental Guidance Standard Default *Exposure Factors* (OSWER Directive, 9285.6-03) dated March 25, 1991 and more recent information from U.S. EPA's Office of Solid Waste and Emergency Response, U.S. EPA's Office of Research and Development, and California EPA's Department of Toxic Substances Control (see Exhibit 4-1).

Because contact rates may be different for children and adults, carcinogenic risks during the first 30 years of life were calculated using age-adjusted factors ("adj"). Use of age-adjusted factors are especially important for soil ingestion exposures, which are higher during childhood and decrease with age. However, for purposes of combining exposures across pathways, additional age-adjusted factors are used for inhalation and dermal exposures. These factors approximate the integrated exposure from birth until age 30 combining contact rates, body weights, and exposure durations for two age groups - small children and adults. Age-adjusted factors were obtained from RAGS PART B or developed by analogy (see derivations next page).

For soils only, noncarcinogenic contaminants are evaluated in children separately from adults. No age-adjustment factor is used in this case. The focus on children is considered protective of the higher daily intake rates of soil by children and their lower body weight. For maintaining consistency when evaluating soils, dermal and inhalation exposures are also based on childhood contact rates.

(1) ingestion([mg-yr]/[kg-d]):

$$IFS_{adj} = \frac{ED_c \times IRS_c}{BW_c} + \frac{(ED_r - ED_c) \times IRS_a}{BW_a}$$

(2) skin contact([mg-yr]/[kg-d]):

$$SFS_{adj} = \frac{ED_c \times AF \times SA_c}{BW_c} + \frac{(ED_r - ED_c) \times AF \times SA_a}{BW_a}$$

(3) inhalation ([m³-yr]/[kg-d]):

$$InhF_{adj} = \frac{ED_c \times IRA_c}{BW_c} + \frac{(ED_r - ED_c) \times IRA_a}{BW_a}$$

EXHIBIT 4-1 STANDARD DEFAULT FACTORS

<u>Symbol</u>	<u>Definition (units)</u>	<u>Default</u>	<u>Reference</u>
CSFo	Cancer slope factor oral (mg/kg-d) ⁻¹	--	IRIS, HEAST, or NCEA
CSFi	Cancer slope factor inhaled (mg/kg-d) ⁻¹	--	IRIS, HEAST, or NCEA
RfDo	Reference dose oral (mg/kg-d)	---	IRIS, HEAST, or NCEA
RfDi	Reference dose inhaled (mg/kg-d)	---	IRIS, HEAST, or NCEA
TR	Target cancer risk	10 ⁻⁶	--
THQ	Target hazard quotient	1	--
BWa	Body weight, adult (kg)	70	RAGS (Part A), EPA 1989 (EPA/540/1-89/002)
BWc	Body weight, child (kg)	15	Exposure Factors, EPA 1991 (OSWER No. 9285.6-03)
ATc	Averaging time - carcinogens (days)	25550	RAGS(Part A), EPA 1989 (EPA/540/1-89/002)
ATn	Averaging time - noncarcinogens (days)	ED*365	
SAa	Exposed surface area for soil/dust (cm ² /day)		Dermal Assessment, EPA 1999 (EPA/540/R-99/005)
	– adult resident	5700	
	– adult worker	3300	
SAc	Exposed surface area, child in soil (cm ² /day)	2800	Dermal Assessment, EPA 1999 (EPA/540/R-99/005)
AFa	Adherence factor, soils (mg/cm ²)		Dermal Assessment, EPA 1999 (EPA/540/R-99/005)
	– adult resident	0.07	
	– adult worker	0.2	
AFc	Adherence factor, child (mg/cm ²)	0.2	Dermal Assessment, EPA 1999 (EPA/540/R-99/005)
ABS	Skin absorption defaults (unitless):		
	– semi-volatile organics	0.1	Dermal Assessment, EPA 1999 (EPA/540/R-99/005)
	– volatile organics	--	Dermal Assessment, EPA 1999 (EPA/540/R-99/005)
	– inorganics	--	Dermal Assessment, EPA 1999 (EPA/540/R-99/005)
IRAA	Inhalation rate - adult (m ³ /day)	20	Exposure Factors, EPA 1991 (OSWER No. 9285.6-03)
IRAc	Inhalation rate - child (m ³ /day)	10	Exposure Factors, EPA 1997 (EPA/600/P-95/002Fa)
IRWa	Drinking water ingestion - adult (L/day)	2	RAGS(Part A), EPA 1989 (EPA/540/1-89/002)
IRWc	Drinking water ingestion - child (L/day)	1	PEA, Cal-EPA (DTSC, 1994)
IRSa	Soil ingestion - adult (mg/day)	100	Exposure Factors, EPA 1991 (OSWER No. 9285.6-03)
IRSc	Soil ingestion - child (mg/day)	200	Exposure Factors, EPA 1991 (OSWER No. 9285.6-03)
IRSo	Soil ingestion - occupational (mg/day)	50	Exposure Factors, EPA 1991 (OSWER No. 9285.6-03)
EFr	Exposure frequency - residential (d/y)	350	Exposure Factors, EPA 1991 (OSWER No. 9285.6-03)
EFo	Exposure frequency - occupational (d/y)	250	Exposure Factors, EPA 1991 (OSWER No. 9285.6-03)
EDr	Exposure duration - residential (years)	30*	Exposure Factors, EPA 1991 (OSWER No. 9285.6-03)
EDc	Exposure duration - child (years)	6	Exposure Factors, EPA 1991 (OSWER No. 9285.6-03)
EDo	Exposure duration - occupational (years)	25	Exposure Factors, EPA 1991 (OSWER No. 9285.6-03)
	Age-adjusted factors for carcinogens:		
IFSadj	Ingestion factor, soils ([mg-yr]/[kg-d])	114	RAGS(Part B), EPA 1991 (OSWER No. 9285.7-01B)
SFSadj	Dermal factor, soils ([mg-yr]/[kg-d])	361	By analogy to RAGS (Part B)
InhFadj	Inhalation factor, air ([m ³ -yr]/[kg-d])	11	By analogy to RAGS (Part B)
IFWadj	Ingestion factor, water ([L-yr]/[kg-d])	1.1	By analogy to RAGS (Part B)
VFw	Volatilization factor for water (L/m ³)	0.5	RAGS(Part B), EPA 1991 (OSWER No. 9285.7-01B)
PEF	Particulate emission factor (m ³ /kg)	See below	Soil Screening Guidance (EPA 1996a,b)
VF _s	Volatilization factor for soil (m ³ /kg)	See below	Soil Screening Guidance (EPA 1996a,b)
sat	Soil saturation concentration (mg/kg)	See below	Soil Screening Guidance (EPA 1996a,b)

Footnote:

*Exposure duration for lifetime residents is assumed to be 30 years total. For carcinogens, exposures are combined for children (6 years) and adults (24 years).

4.8 Standardized Equations

The equations used to calculate the PRGs for carcinogenic and noncarcinogenic contaminants are presented in Equations 4-1 through 4-8. The PRG equations update RAGS Part B equations. The methodology backcalculates a soil, air, or water concentration level from a target risk (for carcinogens) or hazard quotient (for noncarcinogens). For completeness, the soil equations combine risks from ingestion, skin contact, and inhalation simultaneously. Note: the electronic version of the table also includes pathway-specific PRGs, should the user decide against combining specific exposure pathways; or, the user wants to identify the relative contribution of each pathway to exposure.

To calculate PRGs for volatile chemicals in soil, a chemical-specific volatilization factor is calculated per Equation 4-9. Because of its reliance on Henry's law, the VF_s model is applicable only when the contaminant concentration in soil is at or below saturation (i.e. there is no free-phase contaminant present). Soil saturation ("sat") corresponds to the contaminant concentration in soil at which the adsorptive limits of the soil particles and the solubility limits of the available soil moisture have been reached. Above this point, pure liquid-phase contaminant is expected in the soil. If the PRG calculated using VF_s was greater than the calculated sat, the PRG was set equal to sat, in accordance with *Soil Screening Guidance* (USEPA 1996 a,b). The equation for deriving sat is presented in Equation 4-10.

PRG EQUATIONS

Soil Equations: For soils, equations were based on three exposure routes (ingestion, skin contact, and inhalation).

Equation 4-1: Combined Exposures to Carcinogenic Contaminants in Residential Soil

$$C(\text{mg/kg}) = \frac{TR \times AT_c}{EF_r \left[\left(\frac{IFS_{adj} \times CSF_o}{10^6 \text{mg/kg}} \right) + \left(\frac{SFS_{adj} \times ABS \times CSF_o}{10^6 \text{mg/kg}} \right) + \left(\frac{InhF_{adj} \times CSF_i}{VF_s^a} \right) \right]}$$

Equation 4-2: Combined Exposures to Noncarcinogenic Contaminants in Residential Soil

$$C(\text{mg/kg}) = \frac{THQ \times BW_c \times AT_n}{EF_r \times ED_c \left[\left(\frac{1}{RfD_o} \times \frac{IRS_c}{10^6 \text{mg/kg}} \right) + \left(\frac{1}{RfD_o} \times \frac{SA_c \times AF \times ABS}{10^6 \text{mg/kg}} \right) + \left(\frac{1}{RfD_i} \times \frac{IRA_c}{VF_s^a} \right) \right]}$$

Equation 4-3: Combined Exposures to Carcinogenic Contaminants in Industrial Soil

$$C(\text{mg/kg}) = \frac{TR \times BW_a \times AT_c}{EF_o \times ED_o \left[\left(\frac{IRS_o \times CSF_o}{10^6 \text{mg/kg}} \right) + \left(\frac{SA_a \times AF \times ABS \times CSF_o}{10^6 \text{mg/kg}} \right) + \left(\frac{IRA_a \times CSF_i}{VF_s^a} \right) \right]}$$

Footnote:

^aUse VF_s for volatile chemicals (defined as having a Henry's Law Constant [$\text{atm}\cdot\text{m}^3/\text{mol}$] greater than 10^{-5} and a molecular weight less than 200 grams/mol) or PEF for non-volatile chemicals.

Equation 4-4: Combined Exposures to Noncarcinogenic Contaminants in Industrial Soil

$$C(\text{mg/kg}) = \frac{THQ \times BW_a \times AT_n}{EF_o \times ED_o \left[\left(\frac{1}{RfD_o} \times \frac{IRS_o}{10^6 \text{mg/kg}} \right) + \left(\frac{1}{RfD_o} \times \frac{SA_a \times AF \times ABS}{10^6 \text{mg/kg}} \right) + \left(\frac{1}{RfD_i} \times \frac{IRA_a}{VF_s^a} \right) \right]}$$

Tap Water Equations:

Equation 4-5: Ingestion and Inhalation Exposures to Carcinogenic Contaminants in Water

$$C(\text{ug/L}) = \frac{TR \times AT_c \times 1000 \text{ug/mg}}{EF_r \left[(IFW_{adj} \times CSF_o) + (VF_w \times InhF_{adj} \times CSF_i) \right]}$$

Equation 4-6: Ingestion and Inhalation Exposures to Noncarcinogenic Contaminants in Water

$$C(\text{ug/L}) = \frac{THQ \times BW_a \times AT_n \times 1000 \text{ug/mg}}{EF_r \times ED_r \left[\left(\frac{IRW_a}{RfD_o} \right) + \left(\frac{VF_w \times IRA_a}{RfD_i} \right) \right]}$$

Air Equations:

Equation 4-7: Inhalation Exposures to Carcinogenic Contaminants in Air

$$C(\text{ug/m}^3) = \frac{TR \times AT_c \times 1000 \text{ug/mg}}{EF_r \times InhF_{adj} \times CSF_i}$$

Equation 4-8: Inhalation Exposures to Noncarcinogenic Contaminants in Air

$$C(\text{ug/m}^3) = \frac{THQ \times RfD_i \times BW_a \times AT_n \times 1000 \text{ug/mg}}{EF_r \times ED_r \times IRA_a}$$

Footnote:

^aUse VF_s for volatile chemicals (defined as having a Henry's Law Constant [atm-m³/mol] greater than 10⁻⁵ and a molecular weight less than 200 grams/mol) or PEF for non-volatile chemicals.

SOIL-TO-AIR VOLATILIZATION FACTOR (VF_s)

Equation 4-9: Derivation of the Volatilization Factor

$$VF_s (m^3/kg) = (Q/C) \times \frac{(3.14 \times D_A \times T)^{1/2}}{(2 \times \rho_b \times D_A)} \times 10^{-4} (m^2/cm^2)$$

where:

$$D_A = \frac{[(\Theta_a^{10/3} D_i H' + \Theta_w^{10/3} D_w) / n^2]}{\rho_b K_d + \Theta_w + \Theta_a H'}$$

<u>Parameter</u>	<u>Definition (units)</u>	<u>Default</u>
VF _s	Volatilization factor (m ³ /kg)	--
D _A	Apparent diffusivity (cm ² /s)	--
Q/C	Inverse of the mean conc. at the center of a 0.5-acre square source (g/m ² -s per kg/m ³)	68.81
T	Exposure interval (s)	9.5 x 10 ⁸
ρ _b	Dry soil bulk density (g/cm ³)	1.5
Θ _a	Air filled soil porosity (L _{air} /L _{soil})	0.28 or n-Θ _w
n	Total soil porosity (L _{pore} /L _{soil})	0.43 or 1 - (ρ _s /ρ _s)
Θ _w	Water-filled soil porosity (L _{water} /L _{soil})	0.15
ρ _s	Soil particle density (g/cm ³)	2.65
D _i	Diffusivity in air (cm ² /s)	Chemical-specific
H	Henry's Law constant (atm-m ³ /mol)	Chemical-specific
H'	Dimensionless Henry's Law constant	Calculated from H by multiplying by 41 (USEPA 1991a)
D _w	Diffusivity in water (cm ² /s)	Chemical-specific
K _d	Soil-water partition coefficient (cm ³ /g) = K _{oc} f _{oc}	Chemical-specific
K _{oc}	Soil organic carbon-water partition coefficient (cm ³ /g)	Chemical-specific
f _{oc}	Fraction organic carbon in soil (g/g)	0.006 (0.6%)

SOIL SATURATION CONCENTRATION (sat)

Equation 4-10: Derivation of the Soil Saturation Limit

$$sat = \frac{S}{\rho_b} (K_d \rho_b + \Theta_w + H' \Theta_a)$$

<u>Parameter</u>	<u>Definition (units)</u>	<u>Default</u>
sat	Soil saturation concentration (mg/kg)	--
S	Solubility in water (mg/L-water)	Chemical-specific
ρ_b	Dry soil bulk density (kg/L)	1.5
n	Total soil porosity (L_{pore}/L_{soil})	0.43 or $1 - (\rho_b/\rho_s)$
ρ_s	Soil particle density (kg/L)	2.65
K_d	Soil-water partition coefficient (L/kg)	$K_{oc} \times f_{oc}$ (chemical-specific)
K_{oc}	Soil organic carbon/water partition coefficient (L/kg)	Chemical-specific
f_{oc}	Fraction organic carbon content of soil (g/g)	0.006 or site-specific
Θ_w	Water-filled soil porosity (L_{water}/L_{soil})	0.15
Θ_a	Air filled soil porosity (L_{air}/L_{soil})	0.28 or $n - \Theta_w$
w	Average soil moisture content (kg_{water}/kg_{soil} or L_{water}/kg_{soil})	0.1
H	Henry's Law constant (atm-m ³ /mol)	Chemical-specific
H'	Dimensionless Henry's Law constant	$H \times 41$, where 41 is a units conversion factor

SOIL-TO-AIR PARTICULATE EMISSION FACTOR (PEF)

Equation 4-11: Derivation of the Particulate Emission Factor

$$PEF(m^3/kg) = Q/C \times \frac{3600s/h}{0.036 \times (1-V) \times (U_m/U_t)^3 \times F(x)}$$

<u>Parameter</u>	<u>Definition (units)</u>	<u>Default</u>
PEF	Particulate emission factor (m ³ /kg)	1.316 x 10 ⁹
Q/C	Inverse of the mean concentration at the center of a 0.5-acre-square source (g/m ² -s per kg/m ³)	90.80
V	Fraction of vegetative cover (unitless)	0.5
U _m	Mean annual windspeed (m/s)	4.69
U _t	Equivalent threshold value of windspeed at 7 m (m/s)	11.32
F(x)	Function dependent on U _m /U _t derived using Cowherd (1985) (unitless)	0.194

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Appendix H

Sampling and Analysis Matrix

Field Samples Coll 1 for NMCRC-LA

Field Sample I.D. No.	Date Collected	Number of Samples	Analytical Parameters																							Comments		
			Soil	Water	Metals 6010/7471	Organic Lead	pH 9045	VOCs & MIBE 8260	TPH-g 8015m	TPH-d 8015m	SVOCs 8270	PCBs 8082	Nitrate, Ammonia, TKN	Phosphorus, Sulfate, Sulfide	TOC, Moisture	Total Heterotrophic Plate Count	SPL P - 1PH 8015m	SPL P 8260B BTEX	STLC 8260B	STLC 8270C	STLC 6010	STLC Leachability	Anions	Reactive Sulfide	Alkalinity, TDS, Amonia, TKN		Dissolved gases	
99RC-MW01-S-1-05	11/1/99	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Start of Phase I samples	
99RC-MW01-S-1-10	11/1/99	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
99RC-MW01-S-1-20	11/1/99	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
99RC-MW01-S-1-25	11/1/99	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
99RC-MW01-S-1-15	11/1/99	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Hold-not analyze	
99RC-DP03-S-1-05	11/1/99	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
99RC-DP03-S-1-12	11/1/99	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
99RC-DP03-S-1-18	11/2/99	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
99RC-DP03-S-3-18	11/2/99	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	duplicate	
99RC-DP03-S-1-25	11/2/99	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
99RC-DP07-S-1-05	11/2/99	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
99RC-DP07-S-1-10	11/2/99	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
99RC-DP07-S-1-16	11/2/99	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
99RC-DP07-S-1-21	11/2/99	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
99RC-DP02-S-1-05	11/2/99	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
99RC-DP02-S-1-12	11/2/99	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
99RC-DP02-S-1-18	11/2/99	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
99RC-DP02-S-1-25	11/2/99	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
99RC-GG03-W-1-26.7	11/2/99	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
99RC-GG03-WF-1-26.7	11/2/99	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
99RC-GG02-W-1-26.7	11/2/99	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
99RC-GG02-WF-1-26.7	11/2/99	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		

Field Samples Collected for NMCRC-LA

Field Sample I.D. No.	Date Collected	Number of Samples		Analytical Parameters																				Comments		
		Soil	Water	Metals 6010/7471	Organic Lead	pH 9045	VOCs & MIBE 8260	TPH-g 8015m	TPH-d 8015m	SVOCs 8270	PCBs 8082	Nitrate, Ammonia, IKN	Phosphorus, Sulfate, Sulfide	TOC, Moisture	Total Heterotrophic Plate Count	SPL P - TPH 8015m	SPLP 8260B BTEX	STLC 8260B	STLC 8270C	STLC 6010	STLC Leachability	Anions	Reactive Sulfide		Alkalinity, IDS, Amonia, IKN	Dissolved gases
99RC-DP01-S-1-05	11/3/99	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X								
99RC-DP01-S-1-10	11/3/99	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X								
99RC-DP01-S-1-15	11/3/99	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X								
99RC-DP01-S-1-20	11/3/99	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X							
99RC-DP01-S-1-25	11/3/99	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X							
99RC-DP01-S-3-20	11/3/99	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X								
99RC-DP04-S-1-05	11/3/99	X		X	X	X																				duplicate
99RC-DP04-S-1-12	11/3/99	X		X	X	X																				
99RC-DP04-S-1-18	11/3/99	X		X	X	X																				
99RC-DP04-S-1-25	11/3/99	X		X	X	X																				
99RC-DP05-S-1-05	11/3/99	X		X	X	X																				
99RC-DP05-S-3-05	11/3/99	X		X	X	X																				
99RC-DP05-S-1-12	11/3/99	X		X	X	X																				duplicate
99RC-DP05-S-1-18	11/3/99	X		X	X	X																				
99RC-DP05-S-1-25	11/3/99	X		X	X	X																				
99RC-GG01-W-1-26.7	11/3/99		X	X	X	X	X	X	X	X	X											X	X	X	X	
99RC-GG01-WF-1-26.7	11/3/99		X	X																						
99RC-DP06-S-1-05	11/4/99	X		X	X																					
99RC-DP06-S-1-11	11/4/99	X		X	X																					
99RC-DP06-S-1-16	11/4/99	X		X	X																					
99RC-DP06-S-1-20	11/4/99	X		X	X																					
99RC-MW03-S-1-10	11/4/99	X		X	X																					
99RC-MW03-S-1-15	11/4/99	X		X	X																					
99RC-MW03-S-3-15	11/4/99	X		X	X																					duplicate
99RC-MW03-S-1-20	11/4/99	X		X	X																					
99RC-MW03-S-1-26	11/4/99	X		X	X																					

Field Samples Col 1 for NMCRC-LA

Field Sample I.D. No.	Date Collected	Number of Samples	Analytical Parameters																			Comments				
			Soil	Water	Metals 6010/7471	Organic Lead	pH 9045	VOCs & MIBE 8260	TPH-g 8015m	TPH-d 8015m	SVOCs 8270	PCBs 8082	Nitrate, Ammonia, IKN	Phosphorus, Sulfate, Sulfide	TOC, Moisture	Total Heterotrophic Plate Count	SPLP - TPH 8015m	SPLP 8260B BTEX	STLC 8260B	STLC 8270C	STLC 6010	STLC Leachability	Anions	Reactive Sulfide	Alkalinity, TDS, Ammonia, IKN	Dissolved gases
99RC-MW05-S-1-10	11/5/99	X	X		X	X																				
99RC-MW05-S-1-15	11/5/99	X	X		X	X																				
99RC-MW05-S-3-15	11/5/99	X	X		X	X																				
99RC-MW05-S-1-21	11/5/99	X	X		X	X											X									
99RC-MW05-S-1-26	11/5/99	X	X		X	X																				
99RC-MW04-S-1-05	11/8/99	X	X		X	X																				
99RC-MW04-S-1-10	11/8/99	X	X		X	X																				
99RC-MW04-S-1-15	11/8/99	X	X		X	X																				
99RC-MW04-S-3-15	11/8/99	X	X		X	X																				
99RC-MW04-S-1-20	11/8/99	X	X		X	X																				
99RC-MW02-S-1-05	11/9/99	X	X		X	X						X														
99RC-MW02-S-1-10	11/9/99	X	X		X	X						X														
99RC-MW02-S-1-21	11/9/99	X	X		X	X						X														
99RC-MW02-S-1-26	11/9/99	X	X		X	X						X														
99RC-MW05-W-1-22	11/15/99	X	X		X	X																				
99RC-MW05-WF-1-22	11/15/99	X	X		X	X																				
99RC-MW03-W-1-29	11/15/99	X	X		X	X																	X	X	X	
99RC-MW03-WF-1-29	11/15/99	X	X		X	X																	X	X	X	
99RC-MW04B-W-1-30	11/15/99	X	X		X	X																				
99RC-MW04B-WF-1-30	11/15/99	X	X		X	X																				
99RC-MW02-W-1-28	11/15/99	X	X		X	X																	X	X	X	
99RC-MW02-WF-1-28	11/15/99	X	X		X	X																		X	X	
99RC-MW02-W-3-28	11/15/99	X	X		X	X																	X	X	X	
99RC-MW02-WF-3-28	11/15/99	X	X		X	X																		X	X	
99RC-MW01-W-1-27	11/15/99	X	X		X	X																		X	X	
99RC-MW01-WF-1-27	11/15/99	X	X		X	X																		X	X	

Field Samples Collected for NMCRC-LA

Field Sample I.D. No.	Date Collected	Number of Samples	Analytical Parameters																				Comments				
			Soil	Water	Metals 6010/7471	Organic Lead	PH 9045	VOCs & MIBE 8260	TPH-g-8015m	TPH-d-8015m	SVOCs 8270	PCBs 8082	Nitrate, Ammonia, TKN	Phosphorus, Sulfate, Sulfide	TOC, Moisture	Total Heterotrophic Plate Count	SPLP - TPH 8015m	SPLP 8260B BTEX	SILC 8260B	SILC 8270C	SILC 6010	STLC Leachability		Anions	Reactive Sulfide	Alkalinity, IDS, Ammonia, TKN	Dissolved gases
00RC-MW07-S-1-05	1/24/00	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Start of Phase II samples
00RC-MW07-S-1-12	1/24/00	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
00RC-MW07-S-1-19	1/24/00	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
00RC-MW07-S-1-25	1/24/00	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
00RC-DP09-S-1-5	1/24/00	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
00RC-DP09-S-1-12	1/24/00	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
00RC-DP09-S-1-19	1/24/00	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
00RC-DP09-S-1-25	1/24/00	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
00RC-DP08-S-1-5	1/25/00	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
00RC-DP08-S-1-12	1/25/00	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
00RC-DP08-S-1-18	1/25/00	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
00RC-DP08-S-1-24	1/25/00	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
00RC-DP08-S-3-24	1/25/00	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	duplicate	
00RC-MW06-S-1-5	1/25/00	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
00RC-MW06-S-1-10	1/25/00	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
00RC-MW06-S-1-15	1/25/00	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
00RC-MW06-S-3-15	1/25/00	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	duplicate	
00RC-MW06-S-1-20	1/25/00	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
00RC-GG09-W-1-25	1/25/00	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
00RC-GG09-WF-1-25	1/25/00	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		

Field Samples Collected for NMCRC-LA

Field Sample I.D. No.	Date Collected	Number of Samples	Analytical Parameters																						Comments	
			Soil	Water	Metals 6010/7471	Organic Lead	pH 9045	VOCs & MIBE 8260	TPH-g 8015m	TPH-d 8015m	SVOCs 8270	PCBs 8082	Nitrate, Ammonia, TKN	Phosphorus, Sulfate, Sulfide	TOC, Moisture	Total Heterotrophic Plate Count	SPLP - TPH 8015m	SPLP 8260B BTEX	STLC 8260B	STLC 8270C	STLC 6010	STLC Leachability	Anions	Reactive Sulfide		Alkalinity, IDS, Amonia, TKN
00RC-DP10-S-1-5	1/26/00		X		X	X	X	X	X	X	X	X														
00RC-DP10-S-1-10	1/26/00		X		X	X	X	X	X	X	X	X														
00RC-DP10-S-1-17	1/26/00		X		X	X	X	X	X	X	X	X					X									
00RC-DP10-S-1-23	1/26/00		X		X	X	X	X	X	X	X	X														
00RC-DP11-S-1-5	1/26/00		X		X	X	X	X	X	X	X	X														
00RC-DP11-S-1-10	1/26/00		X		X	X	X	X	X	X	X	X														
00RC-DP11-S-1-16	1/26/00		X		X	X	X	X	X	X	X	X					X									
00RC-DP11-S-1-24	1/26/00		X		X	X	X	X	X	X	X	X														
00RC-DP11-S-3-24	1/26/00		X		X	X	X	X	X	X	X	X														
00RC-GG08-W-1-26	1/26/00			X	X	X	X	X	X	X	X	X														
00RC-GG08-WF-1-26	1/26/00			X	X																					
00RC-GG10-W-1-29	1/27/00			X	X	X	X	X	X	X	X	X														
00RC-GG10-WF-1-29	1/27/00			X	X																					
00RC-GG11-W-1-29	1/27/00			X	X	X	X	X	X	X	X	X														
00RC-GG11-WF-1-29	1/27/00			X	X																					
00RC-MW01-W-1-27	1/31/00			X	X	X	X	X	X	X	X	X											X	X	X	X
00RC-MW01-WF-1-27	1/31/00			X	X																					
00RC-MW01-W-3-27	1/31/00			X	X	X	X	X	X	X	X	X											X	X	X	X
00RC-MW01-WF-3-27	1/31/00			X	X																					
00RC-MW05-W-1-22	1/31/00			X	X	X	X	X	X	X	X	X											X	X	X	X
00RC-MW05-WF-1-22	1/31/00			X	X																					

Field Samples Collected for NMCRC-LA

Field Sample I.D. No.	Date Collected	Number of Samples	Analytical Parameters																				Comments				
			Soil	Water	Metals 6010/7471	Organic Lead	pH 9045	VOCs & MTBE 8260	TPH-g 8015m	TPH-d 8015m	SVOCs 8270	PCBs 8082	Nitrate, Ammonia, TKN	Phosphorus, Sulfate, Sulfide	TOC, Moisture	Total Heterotrophic Plate Count	SPLP - IPH 8015m	SPLP 8260B BTEX	STLC 8260B	STLC 8270C	STLC 6010	STLC Leachability	Anions	Reactive Sulfide	Alkalinity, IDS, Ammonia, TKN	Dissolved gases	
00RC-MW07-W-1-23	2/1/00			X	X	X	X	X	X	X	X	X											X	X	X	X	
00RC-MW07-WF-1-23	2/1/00			X	X																		X	X	X	X	
00RC-MW06-W-1-22	2/1/00			X	X	X	X	X	X	X	X	X											X	X	X	X	
00RC-MW06-WF-1-22	2/1/00			X	X																		X	X	X	X	
00RC-MW02-W-1-28	2/1/00			X	X	X	X	X	X	X	X	X											X	X	X	X	
00RC-MW02-WF-1-28	2/1/00			X	X																		X	X	X	X	
Trip Blanks																											
99RC-BT01-W-9-00	11/1/99			X				X																			
99RC-BT02-W-9-00	11/2/99			X				X																			
99RC-BT03-W-9-00	11/3/99			X				X																			
99RC-BT04-W-9-00	11/9/99			X				X																			
99RC-BT05-W-9-00	11/15/99			X				X																			
00RC-BT06-W-9-00	1/24/00			X				X																			
00RC-BT07-W-9-00	1/25/00			X				X																			
00RC-BT08-W-9-00	1/26/00			X				X																			
00RC-BT09-W-9-00	1/27/00			X				X																			
00RC-BT10-W-9-00	1/31/00			X				X																			
00RC-BT11-W-9-00	2/1/00			X				X																			
Field Blanks																											
99RC-MW01-W-7-00	11/15/99		X	X	X	X	X	X	X	X	X	X															applies to all Phase I samples
00RC-MW01-W-7-00	1/31/00		X	X	X	X	X	X	X	X	X	X											X	X	X	X	applies to all Phase II samples

Field Samples Coll 1 for NMCRC-LA

Field Sample I.D. No.	Date Collected	Number of Samples	Analytical Parameters																				Comments					
			Soil	Water	Metals 6010/7471	Organic Lead	pH 9045	VOCs & MIBE 8260	TPH-g 8015m	TPH-d 8015m	SVOCs 8270	PCBs 8082	Nitrate, Ammonia, IKN	Phosphorus, Sulfate, Sulfide	TOC, Moisture	Total Heterotrophic Plate Count	SPL P - TPH 8015m	SPL P 8260B BTEX	SILC 8260B	SILC 8270C	SILC 6010	SILC Leachability	Anions	Reactive Sulfide	Alkalinity, IDS, Ammonia, TKN	Dissolved gases		
Equipment Rinsates																												
99RC-MW02-W-5-05	11/9/99			X	X	X	X	X	X	X	X	X	X															applies to all Phase I soil samples
99RC-MW02-W-5-28	11/15/99			X	X	X	X	X	X	X	X	X	X															applies to all Phase I water samples
99RC-Tube-W-5-00	11/15/99		X								X																	applies to all MW water samples
00RC-DP10-W-5-5	1/26/00		X	X	X	X	X	X	X	X	X	X	X															applies to all Phase II soil samples
00RC-MW01-W-5-27	1/31/00		X	X	X	X	X	X	X	X	X	X	X										X	X	X	X	X	applies to all Phase II water samples
X = tested																												
† = tested but not requested on COC form																												

X = tested

r = tested but not requested on COC form

Appendix I
Field QC Sample Results

Table I-1
Field QC Sample Detected Results for Phase I and Phase II Sampling
NMCRC - LA, 1999-2000

Type	Equipment Rinsate bailer	Phase I	Phase II	Equipment Rinsate groundwater tubing	Phase I & II	Phase I	Phase II	Equipment Rinsate Soil sampling equipment	Field Blank	Phase I	Phase II	Phase I	Phase II	Trip Blanks ^(a) (11 total)
Sample Name	99RC-MW02-W-5-28	00RC-MW01-W-5-27	99RC-Tube-5-00	11/15/1999	11/09/1999	00RC-MW02-5-05	00RC-DP10-W-5-5	99RC-MW01-W-7-00	00RC-MW01-W-7-00	11/1-15/99	2/1/2000	11/1-15/99	1/24-2/1/00	6 samples
Date collected														
VOCs (µg/L)														
1,2-Dichloroethane	ND	ND	N/A	ND	ND	ND	ND	ND	ND	2J	ND	2J	ND	ND
1,2,4-Trimethylbenzene	0.8J	ND	N/A	ND	2J	3J	ND	ND	ND	ND	ND	ND	ND	ND
1,3,5-Trimethylbenzene	ND	ND	N/A	ND	0.5J	0.9J	ND	ND	ND	ND	ND	ND	ND	ND
4-Methyl 2-Pentanone	ND	ND	N/A	ND	ND	0.6J	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	2J	3J	N/A	ND	14	43	ND	ND	ND	0.9J, 1J, 0.6J, 1J, 1J	ND	ND	ND	ND
Isopropylbenzene	ND	ND	N/A	ND	ND	1J	ND	ND	ND	ND	ND	ND	ND	ND
Methylene Chloride	ND ^(e)	ND	N/A	ND	ND	1J ^(e)	ND ^(e)	ND	ND	6J ^(e)	ND	ND	1J, 4J ^(e)	ND
Methyl-Tertiary-Butyl Ether	2J	2J	N/A	ND	4J	2J	ND	ND	ND	ND	ND	ND	ND	ND
N-Propylbenzene	ND	ND	N/A	ND	ND	0.9J	ND	ND	ND	ND	ND	ND	ND	ND
Toluene	ND	ND	N/A	ND	0.5J	2J	ND	ND	ND	5J	ND	ND	5J, 6J	ND
M/P-Xylene	2J	3J	N/A	ND	13J	37J	ND	ND	ND	1J, 2J, 9J, 1J, 1J	3J	ND	ND	ND
O-Xylene	ND	1J	N/A	ND	10J	24	ND	ND	ND	1J, 2J, 9J, 1J, 1J	1J	ND	ND	ND
SVOCs (µg/L)														
Bis(2-Ethylhexyl) Phthalate	ND	ND ^(e)	73J	ND	ND	ND	ND	ND	ND	N/A	ND	N/A	N/A	N/A
Butyl Benzyl Phthalate	ND	ND	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Di-N-Butyl Phthalate	2J	ND	2J	ND	2J	5J	ND	ND	ND	N/A	ND	N/A	N/A	N/A
Dietyl Phthalate	3J	ND	2J	ND	4J	9J	ND	ND	ND	N/A	3	N/A	N/A	N/A
TPH-gasoline (mg/L)	0.03J	ND ^(e)	ND	ND	0.1	0.36	ND ^(e)	0.03	ND ^(e)	N/A	ND ^(e)	N/A	N/A	N/A
TPH-diesel (mg/L)	0.06J	0.2J	N/A	ND	0.04J	0.2J	0.07	0.1J	0.1J	N/A	0.1J	N/A	N/A	N/A
TPH-motor oil (mg/L)	ND	0.05J	N/A	ND	ND	0.1J	ND	0.03J	0.03J	N/A	0.03J	N/A	N/A	N/A

Table I-1 (continued)
Field QC Sample Detected Results for Phase I and Phase II Sampling
NMCRC - LA, 1999-2000

Type	Equipment Rinsate bailer	Phase I	Phase II	Equipment Rinsate groundwater tubing	Phase I & II	Equipment Rinsate Soil sampling equipment	Field Blank	Trip Blanks ^(a) (11 total)
		99RC-MW02-W-5-28	00RC-MW01-W5-27	99RC-Tube-5-00	99RC-MW02-5-05	00RC-DP10-W-5-5	99RC-MW01-W-7-00	00RC-MW01-W-7-27
Sample Name								
Date collected	11/16/1999	1/31/1999	11/15/1999	11/09/1999	01/26/2000	11/16/1999	2/1/2000	11/1-15/99 1/24-2/1/00
Ammonia (µg/L)	ND	70J	N/A	ND	ND	ND	70	N/A
Metals ^(b) (µg/L)								
Aluminum	ND	46.9J	N/A	ND	56.6J	ND	30.3	N/A
Chromium	ND	ND	N/A	ND	10.3	ND	ND	N/A
Copper	ND	6.9	N/A	ND	283	ND	1.8J	N/A
Iron	32.5J	59.2	N/A	43.3J	658	ND	7.2J	N/A
Lead	ND	ND	N/A	ND	2.7J	ND	ND	N/A
Mercury	0.14J	0.19J	N/A	ND	0.24J	0.27J	0.35	N/A
Molybdenum	ND	ND	N/A	2.3J	ND	ND	ND	N/A
Zinc	10.8J	7.3	N/A	10.6	84.8	10.7J	2.6J	N/A

Notes:

- (a) Analyzed for VOCs only.
- (b) Unfiltered, represents total metals.
- (c) Originally reported as detected, but qualified as not detected during data validation process because of method blank contamination. This also applies to two trip blanks in Phase I and four trip blanks in Phase II for Methylene Chloride.

NMCRC = Naval and Marine Corps Reserve Center - Los Angeles

QC = Quality Control

J = Estimated concentration

VOCs = Volatile Organic Compounds

SVOCs = Semivolatile Organic Compounds

TPH = Total Petroleum Hydrocarbons

mg/L = milligrams per Liter

µg/L = micrograms per Liter

N/A = Not Analyzed

ND = Not Detected

Other analytes not listed in this table were not detected in Field QC samples.

Appendix J

Background Metals Assessment

Appendix J

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APPENDIX J

BACKGROUND METALS ASSESSMENT

This appendix presents metals data for soil and groundwater, discusses statistical calculations used to assess whether metals reported in site samples are indicative of background levels or site contamination, and discusses uncertainties in assessing background metals levels at the NMCRC-LA site. Soil and groundwater results are discussed in separate sections below. Because metals occur naturally in soil and groundwater, it is necessary to differentiate between naturally-occurring (i.e., background) concentrations versus concentrations indicative of contamination related to operations at the NMCRC-LA site.

One of the main objectives of any background assessment, including the assessment performed for this site, is to eliminate background metals from the risk assessment so that the risk assessment can focus on the analytes that are associated with site releases (SWDIV 1998). EPA's Risk Assessment Guidance for Superfund (RAGS) states "If inorganic chemicals are present at the site at naturally occurring levels, they may be eliminated from the quantitative risk assessment" (EPA 1989). This is often a "multifaceted and iterative" process (SWDIV 1998). CERCLA Section 104(3)(A) recognizes that remediating naturally occurring chemicals to levels below background levels is not practical, even when chemical concentrations exceed state- or federally-regulated levels (SWDIV 1998).

The Work Plan for this project was prepared in mid-1998, but was not finalized until 1999 (CDM Federal 1999). It identified an approach to calculating background statistical concentrations that is no longer considered a recommended procedure according to the following three sources:

- *Selecting Inorganic Constituents as Chemical of Potential Concern at Risk Assessments at Hazardous Waste Sites and Permitted Facilities*, California Environmental Protection Agency, Department of Toxic Substances Control (DTSC), 1997.

- *Procedural Guidance for Statistically Analyzing Environmental Background Data*, Southwest Division Naval Facilities Engineering Command (SWDIV), 1998.
- *Handbook for Statistical Analysis of Environmental Background Data*, SWDIV, 1999.

These three sources have been used to perform a more appropriate background assessment, as discussed further in this appendix.

Following identification of the data sets selected (Section J.1), soil and groundwater data are discussed separately (Sections J.2 and J.3, respectively) because the size of the data sets differed and because different statistical procedures were used for the different media. Finally, the work plan approach is discussed (Section J.4) to confirm that its use was not appropriate.

J.1 Data Set Selection

Sampling Design. It should be noted that samples were not collected based on a statistical sampling design. Rather, sampling design was judgmental for the following three reasons:

- This was the second phase of work at this project (the initial sampling effort was completed in 1996) and the source area of contamination was fairly well identified; therefore, there was previous site knowledge to guide the investigation;
- Metals were not the main contaminant of concern at this site, so the sampling design was focused more on collecting data for petroleum hydrocarbons and volatile organic compounds (VOCs);
- Statistical sampling designs typically require many more samples to be collected than judgmental sampling designs, so costs may have been prohibitive.

Validated 1999-2000 data. Metals were not analyzed during the 1996 investigation, so only data from the 1999-2000 investigation were used. Validated data, with resulting qualifiers, were used. No metals data were rejected for this site, so all metals data were useable.

Analytes. Samples were analyzed for a total of 19 metals. These included 17 metals identified in California Title 22 regulations (see Table J-1), plus aluminum and iron.

Aluminum and iron were specifically analyzed for because they are naturally occurring in soil at relatively high concentrations (parts per million) compared to the other 17 metals that typically occur at trace concentrations (parts per billion). If site contaminants contributed aluminum or iron to the naturally occurring levels, results would likely be affected by less than one percent, allowing aluminum and iron to be used in geochemical analyses (see Section J.2.1).

It should be noted that not all 17 metals on the California Title 22 list were suspected as possible site contaminants; rather, this list of metals was selected because it is a standard metals list used for analysis at sites in California. The metals of concern from gasoline were cadmium, lead, and vanadium (SWRCB 1987) and possibly chromium, copper, nickel, and zinc from other service station-related activities. Metals are not typically found in fuels at significant concentrations and were not the main contaminant of concern at this site. Navy guidance suggests that lead is the key recommended metal for analysis at fuel sites (NEESA 1990); organic lead testing at this site did not identify organic lead in site samples (see Section 4.4.5 and 4.5.5). Instead, petroleum hydrocarbons and individual VOCs were the main contaminants of concern.

Non-detect censored data. Many environmental data sets, including metals data for this site, contain non-detect results. These data sets are called censored data. The precise concentration is unknown, but may lie between zero and the reporting limit. For results reported by the laboratory as non-detect, one half the detection limit was used following DTSC and EPA guidance. For results reported by the laboratory as detected, but changed to non-detected (U or UJ) during data validation activities, the sample reporting limit (RL) was used to provide a more conservative (higher) concentration because of the uncertainty of the result. This was the case for many groundwater samples (several metals detected in several calibration and other blank sample results) but only a few soil samples.

Locations. Initially, “background” or “reference” or “ambient” samples located distant from the source area were assessed together with samples from the source area, as discussed in

Section J.4. But because that methodology is flawed (see section J.4), samples were grouped as identified below (see Figure J-1):

- Background area. These are areas away from the source of contamination and away from the hydraulically downgradient areas. The following locations were considered background at this site (see Figure 3-3): for soil, MW03, MW04, DP04, DP05, DP06, and DP07; for groundwater, MW03 and MW04B. Note that MW05 was identified in the Work Plan as a background location, but subsequent results identified this location as a location hydraulically downgradient of the source area.
- Source area. MW01, MW02, DP01, DP02, DP03, DP10, and DP11.
- Non-source and downgradient area. This area includes all samples not from background or source areas. These were located away from the source area, but hydraulically downgradient (south) of the source area. It was believed that inclusion of these non-source, downgradient areas might be different in metals concentrations from the source area, but also would not be appropriate to include with background samples because they might decrease the likelihood of identifying significant differences. These locations included MW05, MW06, MW07, DP08, and DP09.

Filtering. For groundwater samples, unfiltered results were excluded because they were generally somewhat turbid, especially groundwater grab samples. In other words, these samples contain groundwater with some soil particles entrained. Filtered metals samples better represent concentrations of metals dissolved in groundwater, so these results were used. One groundwater grab sample (from location GG08) was still relatively turbid even after using three filters; therefore, the results for this sample were excluded from the background metals assessment.

Soil type. The USCS soil type descriptions throughout the site were relatively uniform. Most soil samples were identified as either clayey sand (SC) or sandy clay (CL). This suggests the different soil samples might be relatively homogeneous with respect to natural metals content. One exception was the sample from 15 feet bgs from location MW06 (downgradient near the property boundary) that was identified as sand (SW).

Duplicate results. Field QC duplicate soil samples were also included in the data set because of soil heterogeneity, while groundwater samples are expected to be more homogeneous, so groundwater duplicate samples were not included. Groundwater from three wells (MW01, MW02, and MW05) was sampled twice (once in November 1999 and once in January/February 2000) to confirm results. Results varied enough (e.g. zinc from well MW02 at 22.3 and 10 $\mu\text{g/L}$) to include both sets of results in the database used for background metals assessment. The total number of samples used in the background assessment for soil was 82 and for groundwater was 16

J.2 Soil

The statistical methods used and the results for soil are discussed below. Soil sample results for metals are presented in Tab 1

J.2.1 Data Review

Summary statistics for each data set are presented in Table J-1. The total number of samples (n), frequency of detection, distribution type, and range of detected values are summarized in Table J-1.

Histograms and Percentile Graphs

Data were viewed graphically to help assess distribution type and identify possible outliers. Histograms and cumulative frequency distributions were viewed (see Tab 2 in this appendix). Initially, all samples were grouped together because metals were not the main site contaminants of concern and it was considered possible that all results might represent the same background population. A few somewhat high results were identified, which may suggest contamination; however, these results were identified in samples away from the source area, as identified below:

- Lead at 37 mg/kg and 23 mg/kg in samples from locations MW06 and MW05, respectively, both of which are over 170 feet downgradient of the source area.
- Cadmium at 5 mg/kg in a sample at location MW06, again away from the source area.
- Molybdenum results in two samples, but again these were from a background location (DP04) or downgradient location (MW07)

Geochemical Correlation

Scatterplots of each metal versus iron and aluminum were also used to identify whether unusually high site sample results were actually geochemically-associated with aluminum or iron (Tab 3). Oxides of these two metals are major adsorbents of other metals, plus iron and aluminum were not considered site contaminants of potential concern.

No results show a good correlation with aluminum. Chromium, cobalt, copper, nickel, vanadium, and zinc show the best correlation with iron (correlation coefficient [R^2] of 0.52 to 0.70, none higher).

Any data points on these scatterplots that are high in one of the 17 metals but not similarly high in iron or aluminum may indicate a data point that might represent contamination. These would appear on the lower right portion of the scatterplots. Lead and cadmium each had one result that were relatively high compared to the iron and aluminum concentrations (at sampling location MW06 for both metals, although at a depth of 5 feet bgs for lead and 20 feet bgs for cadmium).

Groupings

Samples were also grouped into background, source area, and non-background downgradient areas, as discussed in Section J.1 for Locations. Tab 4 shows histograms and summary statistics for each metal.

J.2.2 Statistical Testing

With data sets for eight of the 19 metals having a large proportion of non-detects, coupled with the lack of a statistical sampling design and unequal variances between the groups, non-parametric statistical tests were considered more appropriate than parametrical tests. With three spatial categories of data (background, source, and non-source downgradient areas as discussed in Section J.1), the non-parametrical Kruskal-Wallis test with a significance level of $p=0.05$ was used to identify whether the three data sets for each metal were different or similar. The Kruskal-Wallis test is essentially a non-parametrical analysis of variance (ANOVA) test. Tab 5 shows the details of these results, while Table J-1 summarizes these results.

Results suggest that chromium, cobalt, molybdenum, nickel, and vanadium concentrations from the source area, background, and other non-source areas may be different (with the source area highest in concentrations). Two other findings temper this result:

- Aluminum and iron also showed significantly higher concentrations in the source area. But these two metals were analyzed only because they are considered background metals considered highly unlikely to have been impacted to any significant extent by any site contaminants as discussed in Section J.1. Therefore, it appears that soil samples from the source area may have enriched metals concentrations caused by geochemical correlation with aluminum and iron that may have, at least in part, contributed to slightly higher concentrations in site samples from the source area;
- For two metals (mercury and selenium), non-source areas showed significantly higher concentrations. In addition, for one metal (beryllium), the background locations showed significantly higher concentrations.

The Wilcoxon Rank Sum (WRS) test would be appropriate if there were only two data groups instead of three (or the Gehan test if there are many left-censored non-detect data). It possibly could be more powerful in identifying differences between groups. But as discussed in Section J.1 for “Locations,” it was not clear whether site samples away from the source area but in locations originally not considered background locations should be considered source area samples or background samples.

To be conservative, although there is not convincing evidence (because of the geochemical correlation with aluminum and iron in the source area, which suggests possible natural metals enrichment) that metals concentrations at the NMCRC-LA site are significantly higher than background levels, there is enough evidence to add five metals to the human health risk assessment. The five metals included in the risk assessment in Section 7 are chromium, cobalt, molybdenum, nickel, and vanadium.

J.3 Groundwater

The statistical methods used and the results for groundwater are discussed below. Groundwater sample results for metals are presented in Tab 6.

J.3.1 Data Review

Groundwater data summary statistics are presented in Table J-2.

For groundwater, fewer samples were collected than for soil samples (16 useable results compared to 82 for soil). This makes statistical analyses less powerful

Therefore, analytical results for each sample for each metal were qualitatively reviewed to help analyze whether source area concentration might be higher than other areas. Tab 7 presents histograms and other data for groundwater samples

The highest arsenic result was from sample GG03 in the source area, but the other source area samples for arsenic were non-detect. For chromium, the highest concentration was detected at the source area but also at the same concentration in one distant downgradient well and was not detected in two lube rack source area groundwater samples. Antimony, molybdenum, and lead all had one concentration that appeared to be relatively higher than the other data in each respective data set, but only the lead detection was from the source area (the other two were in

downgradient locations). For antimony and molybdenum, one sample result exceeded the screening criteria (MCL for antimony, PRG for molybdenum), but these samples were collected from locations away from the source area.

For barium, cobalt, nickel, and zinc, at least the three highest results were from the source area. Other sample results generally supported the indication that source area samples appeared to be highest, although the results were strongest for barium and nickel. Lead was detected in only two of the 16 site samples (16.8 $\mu\text{g/L}$ at GG01 at the center of the suspected source area and 6.9 $\mu\text{g/L}$ downgradient), but the source area detection exceeded the MCL of 15 $\mu\text{g/L}$.

J.3.2 Statistical Testing

A similar approach to soil background assessment (Section J.2) was applied to groundwater results. Summary statistics are presented in Table J-2, while detailed results are shown in Tab 6 of this appendix.

The Kruskal-Wallis test of significance between data sets from background, source, and downgradient locations indicated a significant difference for only nickel when a p value of 0.05 was used. (Actually, a significant difference was also identified for two other metals, copper and mercury, but these were highest at downgradient locations rather than the source area). Considering that so few samples ($n=16$) provides less power in detecting differences between groups, a larger p value of 0.20 was used to suggest significance. Four additional metals were identified as possibly being above background: barium, molybdenum, selenium, and zinc. Of these four, only molybdenum was identified as a metal that appeared to be above background levels in the source area for soil. As discussed in Section J.1, selenium was not a suspected site contaminant; it also was not detected in some source area groundwater samples and was not identified above the MCL in any sample.

In summary, data review and statistical analysis results conservatively suggests that the following metals may be above background levels in groundwater and may indicate site contamination: barium, cobalt, lead, nickel, and zinc. These metals are included in the human health risk assessment (Section 7). Antimony (detected in one sample above the MCL but downgradient) and molybdenum (detected in one sample above the PRG screening criteria but downgradient) are also included in the human health risk assessment.

J.4 Work Plan Approach

An attempt was made to calculate statistical background levels using the procedures outlined in the Work Plan to provide as complete an analysis as possible, as well as to confirm that the more recently recommended approaches were more appropriate. Some of the limitations of the Work Plan approach were encountered during this assessment, providing evidence that those procedures were indeed not the best to use, as discussed in the final paragraph of this section.

An estimate of the background concentration was attempted by calculating the upper confidence limit of each metal in the soil samples. The basic steps of this method, designed to follow procedures performed for other SWDIV CLEAN projects (BNI 1995 and 1997; Figure in Appendix G of the Work Plan [CDM Federal 1999]), were as follows:

1. Plot Data, Check for Normality. Cumulative frequency plots and histograms were prepared for both log-transformed and untransformed data. Normality was checked graphically.
2. Outliers. Possible outliers were identified by data points that did not appear on the same line as most other data (i.e., there is a large step on the cumulative frequency plot line to the next data point(s));

Scatterplots of each metal versus iron and aluminum were also used to identify whether possible outliers were actually geochemically-associated with aluminum or iron. Oxides of these two metals are major adsorbents of other metals, plus iron and aluminum were not considered site contaminants of potential concern.

Finally, outliers were only considered for removal from the database if they were suspected to be contaminated samples based upon the sample location (e.g., adjacent to the former gasoline UST/lube rack area). For soil, no results

were excluded from the data set for background calculations. Several results were considered, but were not located in suspected contaminated areas (two for lead from locations MW06 and MW05, one for cadmium at location MW06; and two molybdenum results from DP04 and MW07). Barium, cobalt, and selenium in multiple samples from location DP11 were possible outliers, but these samples had high iron results, suggesting these soil samples were enriched with metals.

For groundwater, a smaller number of samples existed, so outlier assessment was more difficult and it was not appropriate to remove any results.

- 3 The mean concentration (m) and the standard deviation(s) of each metal was calculated.
- 4 A population proportion (p) of 95% was selected and the confidence interval was constructed.
- 5 The probability ($1-\alpha$) with which the confidence interval includes the p was selected to be 95%.
- 6 Tables of the factor K_{95} (coefficient) were used to estimate the upper confidence limit (UCL) of the confidence interval for 82 number of observations for soil and 16 for groundwater; and
- 7 The following equation was used to estimate the U_{CL} : $U_{CL} = m + K_{95}s$.

Any site values above these UCL background values might suggest site contamination.

However, this method is not recommended by DTSC or SWDIV (DTSC 1997 and SWDIV 1998) because approximately 5 percent of the results may be identified as above background, based solely on the fact that an upper 95 percent confidence limit was selected. For example, the 82 arsenic soil sample results appeared normally distributed and the UCL was calculated to be 9.01. Four sample results were identified as exceeding the UCL (9.8, 9.7, 9.5, and 9.1 mg/kg). Given this data set with 82 soil samples, 5 percent of 82 equals 4 samples, which is the same number of sample identified above the UCL. If a lower or higher UCL were selected, this would affect the number of samples above the UCL. In summary, the choice of a confidence level should not impact the results so heavily, so that method of assessing background levels is flawed.

Table J-1
Background Metals Assessment Results for Soil, NMCRC-LA, 1999-2000

Analyte	No. of Samples	No. of Detections	Detection Frequency (%)	Minimum Conc. (mg/kg)	Maximum Conc. (mg/kg)	Kruskal-Wallis p value	For p < 0.05, Area With Highest Rank Average	Above Background at Source
Soil								
Aluminum	82	82	100	3420	20,200	0.03	Source (a)	No (a)
Antimony	82	12	15	0.3	2.9	0.27	--	No
Arsenic	82	75	91	0.64	9.8	0.25	--	No
Barium	82	82	100	30.5	435	0.32	--	No
Beryllium	82	19	23	0.11	0.55	0.001	Background	No
Cadmium	82	54	66	0.042	5	0.13	--	No
Chromium	82	82	100	4.5	37.1	0.001	Source	Yes
Cobalt	82	82	100	2.9	23.8	0.01	Source	Yes
Copper	82	82	100	4.8	35.2	0.33	--	No
Iron	82	82	100	5250	34,600	0.003	Source (a)	No (a)
Lead	82	80	98	2.7	37	0.17	--	No
Mercury	82	50	61	0.01	0.15	0.04	Downgradient	No
Molybdenum	82	32	39	0.79	6.1	0.04	Source	Yes
Nickel	82	82	100	5.6	39.2	0.01	Source	Yes
Selenium	82	38	46	0.19	9.7	0.01	Downgradient	No
Silver	82	2	2	0.065	0.76	(b)	--	No
Thallium	82	2	2	0.47	1.4	(b)	--	No
Vanadium	82	82	100	7.8	82	0.006	Source	Yes
Zinc	82	82	100	13.2	102	0.18	--	No

Notes:

- a Aluminum and iron were considered background metals. Selenium was also not suspected as a site contaminant.
b Frequency of detection insufficient to analyze statistically.

NMCRC-LA = Naval and Marine Corps Reserve Center-Los Angeles
No. = Number

Table J-2
Background Metals Assessment Results for Groundwater, NMCRC-LA, 1999-2000

Analyte	No. of Samples(a)	No. of Detections	Detection Frequency (%)	Minimum Conc. (µg/L)	Maximum Conc. (µg/L)	Kruskal-Wallis p value	For p < 0.20, Area With Highest Rank Average (a)	Above Background at Source
Aluminum	16	2	13	47	131	0.87	--	No
Antimony	16	3	19	2.6	11.3	0.82	--	No
Arsenic	16	3	19	5.2	11.2	0.25	--	No
Barium	16	16	100	14.6	445	0.09	Source	Yes
Beryllium	16	0	0	--	--	(b)	--	No
Cadmium	16	1	6	0.35	0.35	(b)	--	No
Chromium	16	7	44	1.3	4.3	0.85	--	No
Cobalt	16	6	38	0.9	16.5	0.78	--	Yes (c)
Copper	16	13	81	5.7	12.1	0.02	Downgradient	No
Iron	16	9	56	11	784	0.21	--	No (c) (d)
Lead	16	2	13	6.9	16.8	0.56	--	Yes (c)
Mercury	16	12	75	0.16	0.56	0.06	Downgradient	No
Molybdenum	16	16	100	17.3	344	0.17	Background	No
Nickel	16	10	63	3.4	41.2	0.02	Source	Yes
Selenium	16	5	31	13.6	22.6	0.16	Source, Downgradient	(d)
Silver	16	1	6	3.4	3.4	(b)	--	No
Thallium	16	0	0	--	--	(b)	--	No
Vanadium	16	2	13	3.7	4.4	0.78	--	No
Zinc	16	15	93	7.2	24.9	0.12	Source	Yes

Notes:

a Number of samples was less than 20, making statistical analysis less meaningful. Therefore, a p value of 0.20 rather than 0.05 was used to test conservatively for significance.

b Zero or one detection, so frequency of detection insufficient to analyze statistically

c Cobalt, iron, and lead each had one detection in the source area that was the highest site sample value. Even though the p value was not considered significant, these metals were retained as metals possibly above background because of one high detection.

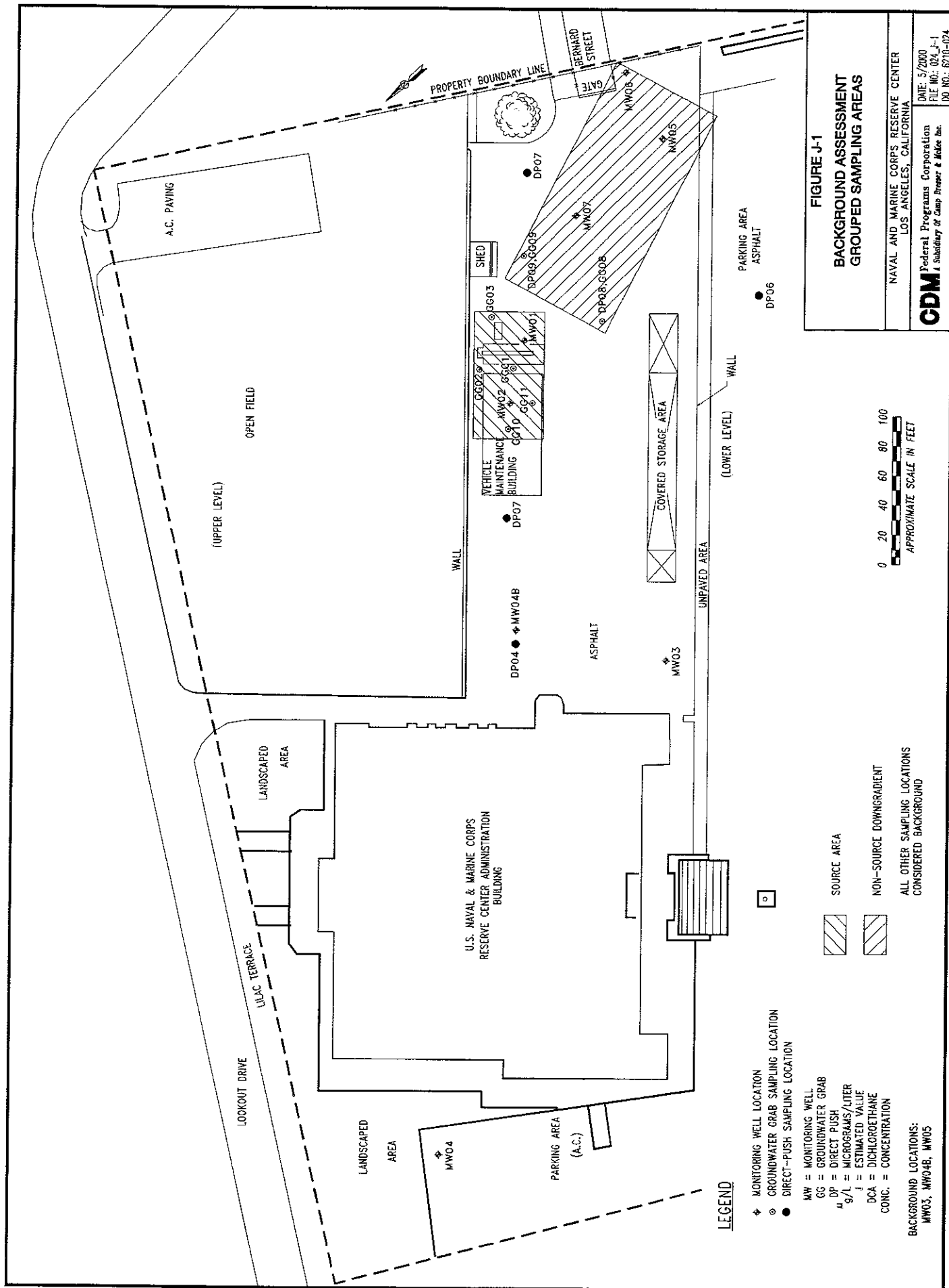
d Selenium was not a suspected site contaminant, so it was considered a background metal (along with aluminum and iron).

The groundwater grab sample from GG08 was not included due to relatively high turbidity even after filtering.

NMCRC-LA = Naval and Marine Corps Reserve Center-Los Angeles

No. = Number

NA = Not Applicable (because of no detections)



Soil Sample Results - Metals

SAMPLE ID NUMBER	TYPE	SAMPLE DATE	ANALYTE	RESULT	Qualifier	UNIT
00RC-DP11-S-1-5	REG	1/26/2000	ALUMINUM	20200		mg/kg
99RC-MW05-S-1-10	REG	11/5/1999	ALUMINUM	19800		mg/kg
99RC-DP01-S-1-10	REG	11/3/1999	ALUMINUM	19500		mg/kg
99RC-DP05-S-1-05	REG	11/3/1999	ALUMINUM	19500		mg/kg
00RC-DP10-S-1-5	REG	1/26/2000	ALUMINUM	19400		mg/kg
00RC-MW07-S-1-05	REG	1/24/2000	ALUMINUM	19100		mg/kg
99RC-DP03-S-3-18	DUP	11/2/1999	ALUMINUM	18900		mg/kg
99RC-DP06-S-1-11	REG	11/4/1999	ALUMINUM	18900		mg/kg
99RC-DP02-S-1-05	REG	11/2/1999	ALUMINUM	18800		mg/kg
00RC-DP11-S-1-16	REG	1/26/2000	ALUMINUM	18500		mg/kg
99RC-DP04-S-1-12	DUP	11/3/1999	ALUMINUM	18500		mg/kg
00RC-DP09-S-1-25	REG	1/24/2000	ALUMINUM	18200		mg/kg
99RC-MW02-S-1-05	REG	11/9/1999	ALUMINUM	18000		mg/kg
00RC-DP09-S-1-5	REG	1/24/2000	ALUMINUM	17800		mg/kg
99RC-DP01-S-1-05	REG	11/3/1999	ALUMINUM	17800		mg/kg
99RC-MW01-S-1-05	REG	11/1/1999	ALUMINUM	17800		mg/kg
99RC-DP02-S-1-12	REG	11/2/1999	ALUMINUM	17200		mg/kg
99RC-MW02-S-1-26	REG	11/9/1999	ALUMINUM	17100		mg/kg
00RC-DP11-S-1-10	REG	1/26/2000	ALUMINUM	17000		mg/kg
99RC-DP04-S-1-05	REG	11/3/1999	ALUMINUM	17000		mg/kg
00RC-DP10-S-1-10	REG	1/26/2000	ALUMINUM	16800		mg/kg
99RC-DP01-S-3-20	DUP	11/3/1999	ALUMINUM	16800		mg/kg
99RC-DP04-S-1-18	DUP	11/3/1999	ALUMINUM	16700		mg/kg
99RC-MW02-S-1-10	REG	11/9/1999	ALUMINUM	16600		mg/kg
99RC-DP05-S-3-05	DUP	11/3/1999	ALUMINUM	16500		mg/kg
99RC-DP02-S-1-18	REG	11/2/1999	ALUMINUM	16400		mg/kg
00RC-DP09-S-1-12	REG	1/24/2000	ALUMINUM	16300		mg/kg
99RC-DP07-S-1-21	REG	11/2/1999	ALUMINUM	16300		mg/kg
99RC-DP01-S-1-15	REG	11/3/1999	ALUMINUM	16200		mg/kg
99RC-DP03-S-1-12	REG	11/1/1999	ALUMINUM	15800		mg/kg
99RC-MW03-S-1-20	REG	11/4/1999	ALUMINUM	15600		mg/kg
99RC-MW01-S-1-10	REG	11/1/1999	ALUMINUM	15500		mg/kg
99RC-MW03-S-1-15	REG	11/4/1999	ALUMINUM	15500		mg/kg
99RC-DP03-S-1-05	REG	11/1/1999	ALUMINUM	15400		mg/kg
99RC-DP05-S-1-12	REG	11/3/1999	ALUMINUM	15400		mg/kg
99RC-DP07-S-1-05	REG	11/2/1999	ALUMINUM	15400		mg/kg
00RC-MW07-S-1-12	REG	1/24/2000	ALUMINUM	15300		mg/kg
99RC-MW03-S-1-10	REG	11/4/1999	ALUMINUM	15300		mg/kg
00RC-DP08-S-3-24	DUP	1/25/2000	ALUMINUM	15200		mg/kg
99RC-MW01-S-1-25	REG	11/1/1999	ALUMINUM	15200		mg/kg
00RC-DP09-S-1-19	REG	1/24/2000	ALUMINUM	15000		mg/kg
00RC-MW06-S-1-10	REG	1/25/2000	ALUMINUM	15000		mg/kg
00RC-DP08-S-1-18	REG	1/25/2000	ALUMINUM	14900		mg/kg
99RC-MW02-S-1-21	REG	11/9/1999	ALUMINUM	14900		mg/kg
00RC-DP08-S-1-12	REG	1/25/2000	ALUMINUM	14700		mg/kg
99RC-MW05-S-1-15	REG	11/5/1999	ALUMINUM	14700		mg/kg
99RC-MW05-S-3-15	DUP	11/5/1999	ALUMINUM	14700		mg/kg
00RC-DP11-S-1-24	REG	1/26/2000	ALUMINUM	14300 J		mg/kg

00RC-DP08-S-1-24	REG	1/25/2000	ALUMINUM	14100	mg/kg
00RC-DP10-S-1-23	REG	1/26/2000	ALUMINUM	14100	mg/kg
99RC-DP05-S-1-25	REG	11/3/1999	ALUMINUM	14000	mg/kg
99RC-MW01-S-1-20	REG	11/1/1999	ALUMINUM	13900	mg/kg
00RC-MW07-S-1-25	REG	1/24/2000	ALUMINUM	13800	mg/kg
99RC-DP02-S-1-25	REG	11/2/1999	ALUMINUM	13800	mg/kg
99RC-DP04-S-1-25	DUP	11/3/1999	ALUMINUM	13800	mg/kg
99RC-MW05-S-1-26	REG	11/5/1999	ALUMINUM	13800	mg/kg
99RC-DP03-S-1-25	REG	11/2/1999	ALUMINUM	13700	mg/kg
00RC-MW07-S-1-19	REG	1/24/2000	ALUMINUM	13500	mg/kg
99RC-DP06-S-1-05	REG	11/4/1999	ALUMINUM	13400	mg/kg
99RC-DP07-S-1-10	REG	11/2/1999	ALUMINUM	13400	mg/kg
99RC-DP03-S-1-18	REG	11/2/1999	ALUMINUM	13300	mg/kg
99RC-MW04-S-1-20	REG	11/8/1999	ALUMINUM	13300	mg/kg
99RC-DP01-S-1-20	REG	11/3/1999	ALUMINUM	13100	mg/kg
99RC-DP05-S-1-18	REG	11/3/1999	ALUMINUM	13000	mg/kg
99RC-DP07-S-1-16	REG	11/2/1999	ALUMINUM	12700	mg/kg
00RC-DP08-S-1-5	REG	1/25/2000	ALUMINUM	12600	mg/kg
99RC-MW03-S-3-15	DUP	11/4/1999	ALUMINUM	12600	mg/kg
99RC-MW04-S-3-15	DUP	11/8/1999	ALUMINUM	12500	mg/kg
00RC-MW06-S-1-5	REG	1/25/2000	ALUMINUM	11500	mg/kg
00RC-DP10-S-1-17	REG	1/26/2000	ALUMINUM	11400	mg/kg
99RC-MW04-S-1-05	REG	11/8/1999	ALUMINUM	11000	mg/kg
99RC-MW04-S-1-10	REG	11/8/1999	ALUMINUM	10900	mg/kg
99RC-MW05-S-1-21	REG	11/5/1999	ALUMINUM	10100	mg/kg
99RC-DP01-S-1-25	REG	11/3/1999	ALUMINUM	9720	mg/kg
99RC-MW04-S-1-15	REG	11/8/1999	ALUMINUM	9470	mg/kg
99RC-DP06-S-1-20	REG	11/4/1999	ALUMINUM	9230	mg/kg
00RC-MW06-S-1-20	REG	1/25/2000	ALUMINUM	9140	mg/kg
99RC-MW03-S-1-26	REG	11/4/1999	ALUMINUM	8870	mg/kg
00RC-DP11-S-3-24	DUP	1/26/2000	ALUMINUM	8400 J	mg/kg
00RC-MW06-S-1-15	REG	1/25/2000	ALUMINUM	6800 J	mg/kg
00RC-MW06-S-3-15	DUP	1/25/2000	ALUMINUM	4350 J	mg/kg
99RC-DP06-S-1-16	REG	11/4/1999	ALUMINUM	3420	mg/kg

SAMPLE ID NUMBER	TYPE	SAMPLE DATE	ANALYTE	RESULT	Qualifier	UNIT
00RC-DP09-S-1-25	REG	1/24/2000	ANTIMONY	4	U	mg/kg
00RC-MW07-S-1-25	REG	1/24/2000	ANTIMONY	3.8	U	mg/kg
00RC-DP10-S-1-5	REG	1/26/2000	ANTIMONY	3.5	J	mg/kg
99RC-DP05-S-1-25	REG	11/3/1999	ANTIMONY	2.9	J	mg/kg
00RC-MW07-S-1-05	REG	1/24/2000	ANTIMONY	2.8	U	mg/kg
00RC-DP11-S-1-24	REG	1/26/2000	ANTIMONY	2.6	U	mg/kg
00RC-DP11-S-3-24	DUP	1/26/2000	ANTIMONY	2.4	U	mg/kg
00RC-DP09-S-1-19	REG	1/24/2000	ANTIMONY	2.2	U	mg/kg
00RC-MW07-S-1-12	REG	1/24/2000	ANTIMONY	2.1	U	mg/kg
00RC-MW06-S-1-5	REG	1/25/2000	ANTIMONY	1.8	J	mg/kg
99RC-MW03-S-1-26	REG	11/4/1999	ANTIMONY	1.6	J	mg/kg
99RC-MW05-S-1-26	REG	11/5/1999	ANTIMONY	1.6	J	mg/kg
00RC-MW06-S-1-20	REG	1/25/2000	ANTIMONY	1.3	J	mg/kg
00RC-DP09-S-1-12	REG	1/24/2000	ANTIMONY	1.2	U	mg/kg
99RC-DP02-S-1-12	REG	11/2/1999	ANTIMONY	1.1	U	mg/kg
99RC-DP03-S-1-12	REG	11/1/1999	ANTIMONY	1	U	mg/kg
99RC-DP01-S-1-25	REG	11/3/1999	ANTIMONY	0.97	J	mg/kg
00RC-DP08-S-1-24	REG	1/25/2000	ANTIMONY	0.95	J	mg/kg
00RC-MW07-S-1-19	REG	1/24/2000	ANTIMONY	0.95	U	mg/kg
99RC-DP06-S-1-20	REG	11/4/1999	ANTIMONY	0.78	J	mg/kg
00RC-DP09-S-1-5	REG	1/24/2000	ANTIMONY	0.56	U	mg/kg
99RC-DP01-S-3-20	DUP	11/3/1999	ANTIMONY	0.37	J	mg/kg
99RC-MW04-S-1-05	REG	11/8/1999	ANTIMONY	0.31	J	mg/kg
99RC-MW03-S-1-20	REG	11/4/1999	ANTIMONY	0.3	J	mg/kg
00RC-DP08-S-1-12	REG	1/25/2000	ANTIMONY		U	mg/kg
00RC-DP08-S-1-18	REG	1/25/2000	ANTIMONY		U	mg/kg
00RC-DP08-S-1-5	REG	1/25/2000	ANTIMONY		U	mg/kg
00RC-DP08-S-3-24	DUP	1/25/2000	ANTIMONY		UJ	mg/kg
00RC-DP10-S-1-10	REG	1/26/2000	ANTIMONY		U	mg/kg
00RC-DP10-S-1-17	REG	1/26/2000	ANTIMONY		U	mg/kg
00RC-DP10-S-1-23	REG	1/26/2000	ANTIMONY		U	mg/kg
00RC-DP11-S-1-10	REG	1/26/2000	ANTIMONY		U	mg/kg
00RC-DP11-S-1-16	REG	1/26/2000	ANTIMONY		U	mg/kg
00RC-DP11-S-1-5	REG	1/26/2000	ANTIMONY		U	mg/kg
00RC-MW06-S-1-10	REG	1/25/2000	ANTIMONY		U	mg/kg
00RC-MW06-S-1-15	REG	1/25/2000	ANTIMONY		U	mg/kg
00RC-MW06-S-3-15	DUP	1/25/2000	ANTIMONY		U	mg/kg
99RC-DP01-S-1-05	REG	11/3/1999	ANTIMONY		U	mg/kg
99RC-DP01-S-1-10	REG	11/3/1999	ANTIMONY		U	mg/kg
99RC-DP01-S-1-15	REG	11/3/1999	ANTIMONY		U	mg/kg
99RC-DP01-S-1-20	REG	11/3/1999	ANTIMONY		UJ	mg/kg
99RC-DP02-S-1-05	REG	11/2/1999	ANTIMONY		U	mg/kg
99RC-DP02-S-1-18	REG	11/2/1999	ANTIMONY		U	mg/kg
99RC-DP02-S-1-25	REG	11/2/1999	ANTIMONY		U	mg/kg
99RC-DP03-S-1-05	REG	11/1/1999	ANTIMONY		U	mg/kg
99RC-DP03-S-1-18	REG	11/2/1999	ANTIMONY		U	mg/kg
99RC-DP03-S-1-25	REG	11/2/1999	ANTIMONY		U	mg/kg
99RC-DP03-S-3-18	DUP	11/2/1999	ANTIMONY		U	mg/kg

99RC-DP04-S-1-05	REG	11/3/1999	ANTIMONY	U	mg/kg
99RC-DP04-S-1-12	DUP	11/3/1999	ANTIMONY	U	mg/kg
99RC-DP04-S-1-18	DUP	11/3/1999	ANTIMONY	U	mg/kg
99RC-DP04-S-1-25	DUP	11/3/1999	ANTIMONY	U	mg/kg
99RC-DP05-S-1-05	REG	11/3/1999	ANTIMONY	U	mg/kg
99RC-DP05-S-1-12	REG	11/3/1999	ANTIMONY	U	mg/kg
99RC-DP05-S-1-18	REG	11/3/1999	ANTIMONY	U	mg/kg
99RC-DP05-S-3-05	DUP	11/3/1999	ANTIMONY	U	mg/kg
99RC-DP06-S-1-05	REG	11/4/1999	ANTIMONY	U	mg/kg
99RC-DP06-S-1-11	REG	11/4/1999	ANTIMONY	U	mg/kg
99RC-DP06-S-1-16	REG	11/4/1999	ANTIMONY	U	mg/kg
99RC-DP07-S-1-05	REG	11/2/1999	ANTIMONY	U	mg/kg
99RC-DP07-S-1-10	REG	11/2/1999	ANTIMONY	U	mg/kg
99RC-DP07-S-1-16	REG	11/2/1999	ANTIMONY	U	mg/kg
99RC-DP07-S-1-21	REG	11/2/1999	ANTIMONY	U	mg/kg
99RC-MW01-S-1-05	REG	11/1/1999	ANTIMONY	U	mg/kg
99RC-MW01-S-1-10	REG	11/1/1999	ANTIMONY	U	mg/kg
99RC-MW01-S-1-20	REG	11/1/1999	ANTIMONY	U	mg/kg
99RC-MW01-S-1-25	REG	11/1/1999	ANTIMONY	U	mg/kg
99RC-MW02-S-1-05	REG	11/9/1999	ANTIMONY	U	mg/kg
99RC-MW02-S-1-10	REG	11/9/1999	ANTIMONY	U	mg/kg
99RC-MW02-S-1-21	REG	11/9/1999	ANTIMONY	U	mg/kg
99RC-MW02-S-1-26	REG	11/9/1999	ANTIMONY	U	mg/kg
99RC-MW03-S-1-10	REG	11/4/1999	ANTIMONY	U	mg/kg
99RC-MW03-S-1-15	REG	11/4/1999	ANTIMONY	U	mg/kg
99RC-MW03-S-3-15	DUP	11/4/1999	ANTIMONY	U	mg/kg
99RC-MW04-S-1-10	REG	11/8/1999	ANTIMONY	U	mg/kg
99RC-MW04-S-1-15	REG	11/8/1999	ANTIMONY	U	mg/kg
99RC-MW04-S-1-20	REG	11/8/1999	ANTIMONY	U	mg/kg
99RC-MW04-S-3-15	DUP	11/8/1999	ANTIMONY	U	mg/kg
99RC-MW05-S-1-10	REG	11/5/1999	ANTIMONY	U	mg/kg
99RC-MW05-S-1-15	REG	11/5/1999	ANTIMONY	U	mg/kg
99RC-MW05-S-1-21	REG	11/5/1999	ANTIMONY	U	mg/kg
99RC-MW05-S-3-15	DUP	11/5/1999	ANTIMONY	U	mg/kg

SAMPLE ID NUMBER	TYPE	SAMPLE DATE	ANALYTE	RESULT	Qualifier	UNIT
00RC-MW07-S-1-25	REG	1/24/2000	ARSENIC	9.8		mg/kg
00RC-DP09-S-1-19	REG	1/24/2000	ARSENIC	9.7		mg/kg
00RC-DP08-S-1-24	REG	1/25/2000	ARSENIC	9.5		mg/kg
99RC-MW05-S-1-26	REG	11/5/1999	ARSENIC	9.1	J	mg/kg
99RC-DP03-S-3-18	DUP	11/2/1999	ARSENIC	8.3	J	mg/kg
99RC-DP04-S-1-05	REG	11/3/1999	ARSENIC	8.2	J	mg/kg
99RC-DP01-S-3-20	DUP	11/3/1999	ARSENIC	8	J	mg/kg
99RC-DP05-S-3-05	DUP	11/3/1999	ARSENIC	7.5	J	mg/kg
99RC-DP05-S-1-05	REG	11/3/1999	ARSENIC	7.3	J	mg/kg
99RC-MW03-S-1-15	REG	11/4/1999	ARSENIC	7.2	J	mg/kg
99RC-MW02-S-1-10	REG	11/9/1999	ARSENIC	7.1		mg/kg
00RC-DP08-S-3-24	DUP	1/25/2000	ARSENIC	7		mg/kg
00RC-DP09-S-1-12	REG	1/24/2000	ARSENIC	6.9		mg/kg
99RC-DP01-S-1-10	REG	11/3/1999	ARSENIC	6.3	J	mg/kg
00RC-DP11-S-1-16	REG	1/26/2000	ARSENIC	6.1		mg/kg
99RC-MW01-S-1-10	REG	11/1/1999	ARSENIC	6		mg/kg
99RC-MW01-S-1-25	REG	11/1/1999	ARSENIC	6		mg/kg
99RC-MW03-S-1-20	REG	11/4/1999	ARSENIC	6	J	mg/kg
99RC-DP02-S-1-18	REG	11/2/1999	ARSENIC	5.9		mg/kg
99RC-MW03-S-3-15	DUP	11/4/1999	ARSENIC	5.8	J	mg/kg
00RC-DP08-S-1-12	REG	1/25/2000	ARSENIC	5.7		mg/kg
00RC-DP11-S-1-24	REG	1/26/2000	ARSENIC	5.7	J	mg/kg
99RC-MW03-S-1-10	REG	11/4/1999	ARSENIC	5.6	J	mg/kg
00RC-DP09-S-1-25	REG	1/24/2000	ARSENIC	5.5		mg/kg
99RC-DP01-S-1-20	REG	11/3/1999	ARSENIC	5.5	J	mg/kg
99RC-DP03-S-1-25	REG	11/2/1999	ARSENIC	5.4		mg/kg
99RC-DP05-S-1-12	REG	11/3/1999	ARSENIC	5.4	J	mg/kg
99RC-MW04-S-1-20	REG	11/8/1999	ARSENIC	5.2	J	mg/kg
00RC-DP10-S-1-10	REG	1/26/2000	ARSENIC	5.1		mg/kg
00RC-MW07-S-1-12	REG	1/24/2000	ARSENIC	5.1		mg/kg
99RC-DP01-S-1-15	REG	11/3/1999	ARSENIC	5.1	J	mg/kg
00RC-DP11-S-1-10	REG	1/26/2000	ARSENIC	5		mg/kg
99RC-DP01-S-1-25	REG	11/3/1999	ARSENIC	4.9	J	mg/kg
00RC-DP08-S-1-18	REG	1/25/2000	ARSENIC	4.8		mg/kg
00RC-DP10-S-1-5	REG	1/26/2000	ARSENIC	4.8		mg/kg
99RC-DP03-S-1-12	REG	11/1/1999	ARSENIC	4.8		mg/kg
00RC-MW07-S-1-19	REG	1/24/2000	ARSENIC	4.7		mg/kg
99RC-DP02-S-1-05	REG	11/2/1999	ARSENIC	4.7		mg/kg
99RC-DP02-S-1-12	REG	11/2/1999	ARSENIC	4.7		mg/kg
00RC-DP10-S-1-23	REG	1/26/2000	ARSENIC	4.6		mg/kg
99RC-DP04-S-1-12	DUP	11/3/1999	ARSENIC	4.5	J	mg/kg
99RC-DP05-S-1-25	REG	11/3/1999	ARSENIC	4.5	J	mg/kg
99RC-DP05-S-1-18	REG	11/3/1999	ARSENIC	4.4	J	mg/kg
99RC-MW02-S-1-26	REG	11/9/1999	ARSENIC	4.3		mg/kg
00RC-DP09-S-1-5	REG	1/24/2000	ARSENIC	4.1		mg/kg
00RC-DP11-S-1-5	REG	1/26/2000	ARSENIC	4.1		mg/kg
99RC-DP04-S-1-25	DUP	11/3/1999	ARSENIC	4.1	J	mg/kg
99RC-MW02-S-1-05	REG	11/9/1999	ARSENIC	4.1		mg/kg

99RC-MW02-S-1-21	REG	11/9/1999 ARSENIC	4 1	mg/kg
99RC-DP04-S-1-18	DUP	11/3/1999 ARSENIC	3.9 J	mg/kg
99RC-DP03-S-1-18	REG	11/2/1999 ARSENIC	3.7 J	mg/kg
00RC-DP08-S-1-5	REG	1/25/2000 ARSENIC	3.6	mg/kg
99RC-MW04-S-1-15	REG	11/8/1999 ARSENIC	3.6 J	mg/kg
99RC-MW05-S-1-21	REG	11/5/1999 ARSENIC	3.6 J	mg/kg
99RC-MW05-S-1-10	REG	11/5/1999 ARSENIC	3.5 J	mg/kg
00RC-DP10-S-1-17	REG	1/26/2000 ARSENIC	3.4	mg/kg
99RC-MW03-S-1-26	REG	11/4/1999 ARSENIC	3.3 J	mg/kg
00RC-MW07-S-1-05	REG	1/24/2000 ARSENIC	3.2	mg/kg
00RC-DP11-S-3-24	DUP	1/26/2000 ARSENIC	3.1 J	mg/kg
00RC-MW06-S-1-5	REG	1/25/2000 ARSENIC	3.1	mg/kg
99RC-MW04-S-1-05	REG	11/8/1999 ARSENIC	3.1 J	mg/kg
99RC-DP07-S-1-05	REG	11/2/1999 ARSENIC	3	mg/kg
99RC-DP01-S-1-05	REG	11/3/1999 ARSENIC	2.8 UJ	mg/kg
00RC-MW06-S-1-10	REG	1/25/2000 ARSENIC	2.7 U	mg/kg
99RC-DP03-S-1-05	REG	11/1/1999 ARSENIC	2.6	mg/kg
99RC-MW01-S-1-20	REG	11/1/1999 ARSENIC	2.6	mg/kg
99RC-DP02-S-1-25	REG	11/2/1999 ARSENIC	2.5	mg/kg
99RC-DP06-S-1-20	REG	11/4/1999 ARSENIC	2.2 J	mg/kg
99RC-MW04-S-3-15	DUP	11/8/1999 ARSENIC	2.2 J	mg/kg
99RC-DP06-S-1-11	REG	11/4/1999 ARSENIC	1.7 J	mg/kg
99RC-MW01-S-1-05	REG	11/1/1999 ARSENIC	1.7	mg/kg
99RC-DP06-S-1-05	REG	11/4/1999 ARSENIC	1.4 J	mg/kg
99RC-DP07-S-1-10	REG	11/2/1999 ARSENIC	1.3 J	mg/kg
99RC-MW04-S-1-10	REG	11/8/1999 ARSENIC	1.2 J	mg/kg
99RC-MW05-S-1-15	REG	11/5/1999 ARSENIC	0.88 J	mg/kg
99RC-DP07-S-1-21	REG	11/2/1999 ARSENIC	0.75 J	mg/kg
00RC-MW06-S-1-15	REG	1/25/2000 ARSENIC	0.67 UJ	mg/kg
99RC-DP06-S-1-16	REG	11/4/1999 ARSENIC	0.64 J	mg/kg
00RC-MW06-S-1-20	REG	1/25/2000 ARSENIC	U	mg/kg
00RC-MW06-S-3-15	DUP	1/25/2000 ARSENIC	UJ	mg/kg
99RC-DP07-S-1-16	REG	11/2/1999 ARSENIC	U	mg/kg
99RC-MW05-S-3-15	DUP	11/5/1999 ARSENIC	UJ	mg/kg

SAMPLE ID NUMBER	TYPE	SAMPLE DATE	ANALYTE	RESULT	Qualifier	UNIT
99RC-DP03-S-1-05	REG	11/1/1999	BARIUM	435		mg/kg
00RC-DP11-S-1-10	REG	1/26/2000	BARIUM	368		mg/kg
00RC-DP11-S-1-16	REG	1/26/2000	BARIUM	357		mg/kg
99RC-DP01-S-1-20	REG	11/3/1999	BARIUM	280	J	mg/kg
00RC-MW06-S-1-20	REG	1/25/2000	BARIUM	271		mg/kg
99RC-DP07-S-1-05	REG	11/2/1999	BARIUM	271		mg/kg
99RC-DP05-S-1-05	REG	11/3/1999	BARIUM	254	J	mg/kg
99RC-MW05-S-1-26	REG	11/5/1999	BARIUM	242		mg/kg
99RC-DP01-S-1-05	REG	11/3/1999	BARIUM	235		mg/kg
99RC-DP02-S-1-18	REG	11/2/1999	BARIUM	227		mg/kg
99RC-MW03-S-1-10	REG	11/4/1999	BARIUM	221		mg/kg
99RC-MW04-S-1-15	REG	11/8/1999	BARIUM	210	J	mg/kg
00RC-MW07-S-1-25	REG	1/24/2000	BARIUM	194		mg/kg
99RC-DP01-S-3-20	DUP	11/3/1999	BARIUM	194	J	mg/kg
99RC-MW03-S-1-20	REG	11/4/1999	BARIUM	193		mg/kg
99RC-MW02-S-1-05	REG	11/9/1999	BARIUM	178		mg/kg
99RC-DP04-S-1-05	REG	11/3/1999	BARIUM	174		mg/kg
99RC-MW03-S-1-15	REG	11/4/1999	BARIUM	173		mg/kg
99RC-DP06-S-1-05	REG	11/4/1999	BARIUM	172		mg/kg
99RC-DP06-S-1-11	REG	11/4/1999	BARIUM	171		mg/kg
99RC-MW05-S-3-15	DUP	11/5/1999	BARIUM	166		mg/kg
00RC-DP08-S-3-24	DUP	1/25/2000	BARIUM	164	J	mg/kg
99RC-DP05-S-3-05	DUP	11/3/1999	BARIUM	160	J	mg/kg
99RC-DP05-S-1-18	REG	11/3/1999	BARIUM	154		mg/kg
00RC-DP10-S-1-10	REG	1/26/2000	BARIUM	149		mg/kg
00RC-DP11-S-1-24	REG	1/26/2000	BARIUM	149	J	mg/kg
00RC-MW06-S-1-10	REG	1/25/2000	BARIUM	144		mg/kg
00RC-MW06-S-1-5	REG	1/25/2000	BARIUM	143		mg/kg
99RC-DP01-S-1-15	REG	11/3/1999	BARIUM	143		mg/kg
99RC-MW01-S-1-25	REG	11/1/1999	BARIUM	143		mg/kg
99RC-DP04-S-1-12	DUP	11/3/1999	BARIUM	141		mg/kg
99RC-DP05-S-1-25	REG	11/3/1999	BARIUM	141		mg/kg
00RC-DP08-S-1-5	REG	1/25/2000	BARIUM	139		mg/kg
99RC-DP03-S-1-18	REG	11/2/1999	BARIUM	138	J	mg/kg
99RC-MW04-S-3-15	DUP	11/8/1999	BARIUM	137	J	mg/kg
99RC-MW01-S-1-10	REG	11/1/1999	BARIUM	136		mg/kg
99RC-MW05-S-1-15	REG	11/5/1999	BARIUM	134		mg/kg
99RC-DP01-S-1-25	REG	11/3/1999	BARIUM	132		mg/kg
00RC-DP08-S-1-18	REG	1/25/2000	BARIUM	127		mg/kg
99RC-DP04-S-1-25	DUP	11/3/1999	BARIUM	125		mg/kg
99RC-DP02-S-1-25	REG	11/2/1999	BARIUM	121		mg/kg
99RC-MW03-S-3-15	DUP	11/4/1999	BARIUM	121		mg/kg
99RC-MW03-S-1-26	REG	11/4/1999	BARIUM	116		mg/kg
99RC-DP03-S-1-25	REG	11/2/1999	BARIUM	115		mg/kg
00RC-DP08-S-1-24	REG	1/25/2000	BARIUM	114	J	mg/kg
00RC-MW07-S-1-19	REG	1/24/2000	BARIUM	113		mg/kg
99RC-DP05-S-1-12	REG	11/3/1999	BARIUM	113		mg/kg
00RC-DP10-S-1-5	REG	1/26/2000	BARIUM	110		mg/kg

99RC-MW05-S-1-10	REG	11/5/1999 BARIUM	110	mg/kg
99RC-DP01-S-1-10	REG	11/3/1999 BARIUM	107	mg/kg
00RC-DP11-S-1-5	REG	1/26/2000 BARIUM	106	mg/kg
99RC-MW02-S-1-26	REG	11/9/1999 BARIUM	103	mg/kg
99RC-DP02-S-1-12	REG	11/2/1999 BARIUM	101	mg/kg
99RC-DP06-S-1-20	REG	11/4/1999 BARIUM	100	mg/kg
99RC-MW02-S-1-10	REG	11/9/1999 BARIUM	99.5	mg/kg
00RC-DP10-S-1-23	REG	1/26/2000 BARIUM	95.3	mg/kg
99RC-MW05-S-1-21	REG	11/5/1999 BARIUM	91.8	mg/kg
99RC-MW01-S-1-05	REG	11/1/1999 BARIUM	88.4	mg/kg
00RC-DP11-S-3-24	DUP	1/26/2000 BARIUM	87.6 J	mg/kg
00RC-DP09-S-1-25	REG	1/24/2000 BARIUM	87	mg/kg
99RC-MW01-S-1-20	REG	11/1/1999 BARIUM	84.7	mg/kg
99RC-DP07-S-1-21	REG	11/2/1999 BARIUM	84	mg/kg
00RC-DP10-S-1-17	REG	1/26/2000 BARIUM	80.7	mg/kg
99RC-DP02-S-1-05	REG	11/2/1999 BARIUM	79.8	mg/kg
99RC-MW04-S-1-10	REG	11/8/1999 BARIUM	79.1	mg/kg
99RC-MW02-S-1-21	REG	11/9/1999 BARIUM	75.9	mg/kg
00RC-MW07-S-1-05	REG	1/24/2000 BARIUM	75	mg/kg
99RC-DP04-S-1-18	DUP	11/3/1999 BARIUM	74.8	mg/kg
99RC-DP03-S-3-18	DUP	11/2/1999 BARIUM	74.1 J	mg/kg
99RC-DP07-S-1-16	REG	11/2/1999 BARIUM	73.5	mg/kg
99RC-MW04-S-1-05	REG	11/8/1999 BARIUM	64.3	mg/kg
99RC-MW04-S-1-20	REG	11/8/1999 BARIUM	62.9	mg/kg
99RC-DP03-S-1-12	REG	11/1/1999 BARIUM	61.9	mg/kg
00RC-DP09-S-1-5	REG	1/24/2000 BARIUM	60.1	mg/kg
00RC-DP09-S-1-19	REG	1/24/2000 BARIUM	57.6	mg/kg
00RC-DP08-S-1-12	REG	1/25/2000 BARIUM	54.8	mg/kg
00RC-MW07-S-1-12	REG	1/24/2000 BARIUM	54.8	mg/kg
00RC-DP09-S-1-12	REG	1/24/2000 BARIUM	51.7	mg/kg
99RC-DP07-S-1-10	REG	11/2/1999 BARIUM	49.8	mg/kg
00RC-MW06-S-1-15	REG	1/25/2000 BARIUM	43.6	mg/kg
99RC-DP06-S-1-16	REG	11/4/1999 BARIUM	39.6	mg/kg
00RC-MW06-S-3-15	DUP	1/25/2000 BARIUM	30.5	mg/kg

SAMPLE ID NUMBER	TYPE	SAMPLE DATE	ANALYTE	RESULT	Qualifier	UNIT
99RC-DP06-S-1-11	REG	11/4/1999	BERYLLIUM	0 55		mg/kg
99RC-MW03-S-1-10	REG	11/4/1999	BERYLLIUM	0 53		mg/kg
99RC-MW03-S-1-15	REG	11/4/1999	BERYLLIUM	0 48		mg/kg
99RC-MW03-S-1-20	REG	11/4/1999	BERYLLIUM	0 45		mg/kg
99RC-MW03-S-3-15	DUP	11/4/1999	BERYLLIUM	0 42		mg/kg
99RC-MW04-S-1-20	REG	11/8/1999	BERYLLIUM	0 36		mg/kg
00RC-DP08-S-1-24	REG	1/25/2000	BERYLLIUM	0 3		mg/kg
99RC-MW04-S-3-15	DUP	11/8/1999	BERYLLIUM	0 3 J		mg/kg
99RC-MW03-S-1-26	REG	11/4/1999	BERYLLIUM	0 29		mg/kg
99RC-MW04-S-1-10	REG	11/8/1999	BERYLLIUM	0 29		mg/kg
00RC-DP08-S-1-12	REG	1/25/2000	BERYLLIUM	0 25		mg/kg
00RC-MW07-S-1-19	REG	1/24/2000	BERYLLIUM	0 23		mg/kg
00RC-DP10-S-1-10	REG	1/26/2000	BERYLLIUM	0 22 J		mg/kg
00RC-DP11-S-1-10	REG	1/26/2000	BERYLLIUM	0 22 J		mg/kg
00RC-DP11-S-1-5	REG	1/26/2000	BERYLLIUM	0 22 J		mg/kg
99RC-DP06-S-1-20	REG	11/4/1999	BERYLLIUM	0 22 J		mg/kg
00RC-DP08-S-3-24	DUP	1/25/2000	BERYLLIUM	0 21		mg/kg
00RC-MW06-S-1-20	REG	1/25/2000	BERYLLIUM	0 21 J		mg/kg
99RC-MW04-S-1-15	REG	11/8/1999	BERYLLIUM	0 19 UJ		mg/kg
00RC-DP09-S-1-19	REG	1/24/2000	BERYLLIUM	0 17 U		mg/kg
00RC-DP11-S-1-24	REG	1/26/2000	BERYLLIUM	0 16 UJ		mg/kg
99RC-MW01-S-1-10	REG	11/1/1999	BERYLLIUM	0 16 U		mg/kg
99RC-MW04-S-1-05	REG	11/8/1999	BERYLLIUM	0 16 U		mg/kg
99RC-MW05-S-1-26	REG	11/5/1999	BERYLLIUM	0 16 U		mg/kg
00RC-DP10-S-1-5	REG	1/26/2000	BERYLLIUM	0 11 J		mg/kg
99RC-DP06-S-1-05	REG	11/4/1999	BERYLLIUM	0 11 U		mg/kg
99RC-MW01-S-1-25	REG	11/1/1999	BERYLLIUM	0 11 U		mg/kg
99RC-MW05-S-1-10	REG	11/5/1999	BERYLLIUM	0 11 U		mg/kg
99RC-DP03-S-1-18	REG	11/2/1999	BERYLLIUM	0 1 UJ		mg/kg
99RC-DP06-S-1-16	REG	11/4/1999	BERYLLIUM	0 1 U		mg/kg
00RC-DP11-S-1-16	REG	1/26/2000	BERYLLIUM	0 096 U		mg/kg
00RC-MW06-S-1-10	REG	1/25/2000	BERYLLIUM	0 088 U		mg/kg
99RC-DP04-S-1-05	REG	11/3/1999	BERYLLIUM	0 079 U		mg/kg
99RC-DP01-S-1-10	REG	11/3/1999	BERYLLIUM	0 068 U		mg/kg
99RC-MW01-S-1-20	REG	11/1/1999	BERYLLIUM	0 067 U		mg/kg
99RC-DP03-S-1-05	REG	11/1/1999	BERYLLIUM	0 063 U		mg/kg
00RC-DP11-S-3-24	DUP	1/26/2000	BERYLLIUM	0 062 UJ		mg/kg
99RC-DP01-S-1-25	REG	11/3/1999	BERYLLIUM	0 055 U		mg/kg
99RC-DP05-S-1-12	REG	11/3/1999	BERYLLIUM	0 054 U		mg/kg
00RC-MW07-S-1-12	REG	1/24/2000	BERYLLIUM	0 05 U		mg/kg
00RC-DP08-S-1-18	REG	1/25/2000	BERYLLIUM	0 037 U		mg/kg
99RC-MW05-S-1-15	REG	11/5/1999	BERYLLIUM	0 036 UJ		mg/kg
99RC-DP01-S-3-20	DUP	11/3/1999	BERYLLIUM	0 029 UJ		mg/kg
00RC-DP10-S-1-23	REG	1/26/2000	BERYLLIUM	0 027 U		mg/kg
99RC-MW02-S-1-26	REG	11/9/1999	BERYLLIUM	0 022 U		mg/kg
00RC-DP09-S-1-25	REG	1/24/2000	BERYLLIUM	0 019 U		mg/kg
99RC-MW05-S-3-15	DUP	11/5/1999	BERYLLIUM	0 018 UJ		mg/kg
99RC-MW05-S-1-21	REG	11/5/1999	BERYLLIUM	0 017 U		mg/kg

00RC-MW07-S-1-25	REG	1/24/2000 BERYLLIUM	0 012 U	mg/kg
00RC-DP08-S-1-5	REG	1/25/2000 BERYLLIUM	U	mg/kg
00RC-DP09-S-1-12	REG	1/24/2000 BERYLLIUM	U	mg/kg
00RC-DP09-S-1-5	REG	1/24/2000 BERYLLIUM	U	mg/kg
00RC-DP10-S-1-17	REG	1/26/2000 BERYLLIUM	U	mg/kg
00RC-MW06-S-1-15	REG	1/25/2000 BERYLLIUM	U	mg/kg
00RC-MW06-S-1-5	REG	1/25/2000 BERYLLIUM	U	mg/kg
00RC-MW06-S-3-15	DUP	1/25/2000 BERYLLIUM	U	mg/kg
00RC-MW07-S-1-05	REG	1/24/2000 BERYLLIUM	U	mg/kg
99RC-DP01-S-1-05	REG	11/3/1999 BERYLLIUM	U	mg/kg
99RC-DP01-S-1-15	REG	11/3/1999 BERYLLIUM	U	mg/kg
99RC-DP01-S-1-20	REG	11/3/1999 BERYLLIUM	UJ	mg/kg
99RC-DP02-S-1-05	REG	11/2/1999 BERYLLIUM	U	mg/kg
99RC-DP02-S-1-12	REG	11/2/1999 BERYLLIUM	U	mg/kg
99RC-DP02-S-1-18	REG	11/2/1999 BERYLLIUM	U	mg/kg
99RC-DP02-S-1-25	REG	11/2/1999 BERYLLIUM	U	mg/kg
99RC-DP03-S-1-12	REG	11/1/1999 BERYLLIUM	U	mg/kg
99RC-DP03-S-1-25	REG	11/2/1999 BERYLLIUM	U	mg/kg
99RC-DP03-S-3-18	DUP	11/2/1999 BERYLLIUM	UJ	mg/kg
99RC-DP04-S-1-12	DUP	11/3/1999 BERYLLIUM	U	mg/kg
99RC-DP04-S-1-18	DUP	11/3/1999 BERYLLIUM	U	mg/kg
99RC-DP04-S-1-25	DUP	11/3/1999 BERYLLIUM	U	mg/kg
99RC-DP05-S-1-05	REG	11/3/1999 BERYLLIUM	U	mg/kg
99RC-DP05-S-1-18	REG	11/3/1999 BERYLLIUM	U	mg/kg
99RC-DP05-S-1-25	REG	11/3/1999 BERYLLIUM	U	mg/kg
99RC-DP05-S-3-05	DUP	11/3/1999 BERYLLIUM	U	mg/kg
99RC-DP07-S-1-05	REG	11/2/1999 BERYLLIUM	U	mg/kg
99RC-DP07-S-1-10	REG	11/2/1999 BERYLLIUM	U	mg/kg
99RC-DP07-S-1-16	REG	11/2/1999 BERYLLIUM	U	mg/kg
99RC-DP07-S-1-21	REG	11/2/1999 BERYLLIUM	U	mg/kg
99RC-MW01-S-1-05	REG	11/1/1999 BERYLLIUM	U	mg/kg
99RC-MW02-S-1-05	REG	11/9/1999 BERYLLIUM	U	mg/kg
99RC-MW02-S-1-10	REG	11/9/1999 BERYLLIUM	U	mg/kg
99RC-MW02-S-1-21	REG	11/9/1999 BERYLLIUM	U	mg/kg

SAMPLE ID NUMBER	TYPE	SAMPLE DATE	ANALYTE	RESULT	Qualifier	UNIT
00RC-MW06-S-1-20	REG	1/25/2000	CADMIUM	5		mg/kg
00RC-DP08-S-3-24	DUP	1/25/2000	CADMIUM	2 5	J	mg/kg
00RC-DP08-S-1-18	REG	1/25/2000	CADMIUM	2		mg/kg
00RC-DP11-S-1-16	REG	1/26/2000	CADMIUM	2		mg/kg
99RC-DP01-S-1-25	REG	11/3/1999	CADMIUM	1 8		mg/kg
99RC-DP04-S-1-05	REG	11/3/1999	CADMIUM	1 8		mg/kg
99RC-MW03-S-1-10	REG	11/4/1999	CADMIUM	1 8		mg/kg
99RC-MW03-S-1-20	REG	11/4/1999	CADMIUM	1 8		mg/kg
00RC-DP11-S-1-10	REG	1/26/2000	CADMIUM	1 7		mg/kg
99RC-MW01-S-1-05	REG	11/1/1999	CADMIUM	1 6		mg/kg
99RC-DP03-S-1-05	REG	11/1/1999	CADMIUM	1 5		mg/kg
99RC-DP05-S-1-05	REG	11/3/1999	CADMIUM	1 5		mg/kg
99RC-MW01-S-1-20	REG	11/1/1999	CADMIUM	1 5		mg/kg
00RC-DP08-S-1-24	REG	1/25/2000	CADMIUM	1 4	J	mg/kg
99RC-DP05-S-3-05	DUP	11/3/1999	CADMIUM	1 4		mg/kg
99RC-MW03-S-1-15	REG	11/4/1999	CADMIUM	1 4		mg/kg
99RC-MW03-S-3-15	DUP	11/4/1999	CADMIUM	1 4		mg/kg
00RC-MW07-S-1-25	REG	1/24/2000	CADMIUM	1 3		mg/kg
99RC-DP01-S-1-10	REG	11/3/1999	CADMIUM	1 3		mg/kg
99RC-DP05-S-1-12	REG	11/3/1999	CADMIUM	1 3		mg/kg
99RC-DP03-S-1-25	REG	11/2/1999	CADMIUM	1 2		mg/kg
99RC-DP03-S-3-18	DUP	11/2/1999	CADMIUM	1 2		mg/kg
99RC-MW01-S-1-10	REG	11/1/1999	CADMIUM	1 2		mg/kg
99RC-MW02-S-1-10	REG	11/9/1999	CADMIUM	1 2		mg/kg
00RC-DP10-S-1-10	REG	1/26/2000	CADMIUM	1 1		mg/kg
99RC-DP02-S-1-12	REG	11/2/1999	CADMIUM	1 1		mg/kg
99RC-DP03-S-1-18	REG	11/2/1999	CADMIUM	1 1		mg/kg
99RC-MW03-S-1-26	REG	11/4/1999	CADMIUM	1 1		mg/kg
99RC-DP01-S-1-20	REG	11/3/1999	CADMIUM	1	J	mg/kg
99RC-DP02-S-1-25	REG	11/2/1999	CADMIUM	1		mg/kg
99RC-MW02-S-1-05	REG	11/9/1999	CADMIUM	1		mg/kg
00RC-DP10-S-1-5	REG	1/26/2000	CADMIUM	0 97		mg/kg
99RC-MW05-S-3-15	DUP	11/5/1999	CADMIUM	0 94	J	mg/kg
99RC-DP02-S-1-05	REG	11/2/1999	CADMIUM	0 92	J	mg/kg
99RC-DP02-S-1-18	REG	11/2/1999	CADMIUM	0 92	J	mg/kg
99RC-DP04-S-1-12	DUP	11/3/1999	CADMIUM	0 92		mg/kg
99RC-DP01-S-1-15	REG	11/3/1999	CADMIUM	0 84		mg/kg
99RC-MW05-S-1-21	REG	11/5/1999	CADMIUM	0 78		mg/kg
00RC-DP08-S-1-5	REG	1/25/2000	CADMIUM	0 72		mg/kg
99RC-DP04-S-1-25	DUP	11/3/1999	CADMIUM	0 7	U	mg/kg
99RC-DP06-S-1-05	REG	11/4/1999	CADMIUM	0 7		mg/kg
99RC-DP01-S-1-05	REG	11/3/1999	CADMIUM	0 67	U	mg/kg
00RC-DP09-S-1-12	REG	1/24/2000	CADMIUM	0 63		mg/kg
00RC-DP09-S-1-5	REG	1/24/2000	CADMIUM	0 62		mg/kg
00RC-DP11-S-1-5	REG	1/26/2000	CADMIUM	0 6		mg/kg
00RC-DP10-S-1-23	REG	1/26/2000	CADMIUM	0 59		mg/kg
99RC-DP07-S-1-05	REG	11/2/1999	CADMIUM	0 59	U	mg/kg
00RC-MW07-S-1-19	REG	1/24/2000	CADMIUM	0 56	U	mg/kg

99RC-DP03-S-1-12	REG	11/1/1999 CADMIUM	0 54	mg/kg
99RC-DP07-S-1-21	REG	11/2/1999 CADMIUM	0 54 J	mg/kg
99RC-DP01-S-3-20	DUP	11/3/1999 CADMIUM	0 53 UJ	mg/kg
00RC-MW07-S-1-05	REG	1/24/2000 CADMIUM	0 52 U	mg/kg
99RC-DP07-S-1-16	REG	11/2/1999 CADMIUM	0 51 J	mg/kg
00RC-DP11-S-3-24	DUP	1/26/2000 CADMIUM	0 5 UJ	mg/kg
00RC-DP09-S-1-25	REG	1/24/2000 CADMIUM	0 49	mg/kg
99RC-MW05-S-1-15	REG	11/5/1999 CADMIUM	0 48 UJ	mg/kg
00RC-MW06-S-1-5	REG	1/25/2000 CADMIUM	0 47	mg/kg
99RC-MW01-S-1-25	REG	11/1/1999 CADMIUM	0 47	mg/kg
99RC-MW05-S-1-26	REG	11/5/1999 CADMIUM	0 47 U	mg/kg
99RC-DP06-S-1-20	REG	11/4/1999 CADMIUM	0 45 U	mg/kg
99RC-DP05-S-1-25	REG	11/3/1999 CADMIUM	0 41 U	mg/kg
00RC-MW06-S-1-10	REG	1/25/2000 CADMIUM	0 39	mg/kg
00RC-DP08-S-1-12	REG	1/25/2000 CADMIUM	0 37	mg/kg
00RC-MW07-S-1-12	REG	1/24/2000 CADMIUM	0 37 U	mg/kg
99RC-DP05-S-1-18	REG	11/3/1999 CADMIUM	0 36 U	mg/kg
99RC-MW02-S-1-26	REG	11/9/1999 CADMIUM	0 36	mg/kg
99RC-MW05-S-1-10	REG	11/5/1999 CADMIUM	0 35 U	mg/kg
99RC-DP06-S-1-11	REG	11/4/1999 CADMIUM	0 31 U	mg/kg
00RC-DP10-S-1-17	REG	1/26/2000 CADMIUM	0 3 U	mg/kg
99RC-DP04-S-1-18	DUP	11/3/1999 CADMIUM	0 26 U	mg/kg
99RC-MW04-S-3-15	DUP	11/8/1999 CADMIUM	0 22 U	mg/kg
99RC-MW04-S-1-15	REG	11/8/1999 CADMIUM	0 2 U	mg/kg
00RC-MW06-S-1-15	REG	1/25/2000 CADMIUM	0 16 UJ	mg/kg
99RC-MW04-S-1-20	REG	11/8/1999 CADMIUM	0 096 U	mg/kg
99RC-DP06-S-1-16	REG	11/4/1999 CADMIUM	0 071 U	mg/kg
00RC-MW06-S-3-15	DUP	1/25/2000 CADMIUM	0 065 UJ	mg/kg
99RC-MW02-S-1-21	REG	11/9/1999 CADMIUM	0 042 J	mg/kg
00RC-DP11-S-1-24	REG	1/26/2000 CADMIUM	0 038 UJ	mg/kg
00RC-DP09-S-1-19	REG	1/24/2000 CADMIUM	U	mg/kg
99RC-DP07-S-1-10	REG	11/2/1999 CADMIUM	U	mg/kg
99RC-MW04-S-1-05	REG	11/8/1999 CADMIUM	U	mg/kg
99RC-MW04-S-1-10	REG	11/8/1999 CADMIUM	U	mg/kg

SAMPLE ID NUMBER	TYPE	SAMPLE DATE	ANALYTE	RESULT	Qualifier	UNIT
99RC-DP05-S-3-05	DUP	11/3/1999	CHROMIUM	37.1		mg/kg
99RC-DP03-S-3-18	DUP	11/2/1999	CHROMIUM	33		mg/kg
99RC-DP01-S-1-10	REG	11/3/1999	CHROMIUM	30.4		mg/kg
99RC-DP05-S-1-05	REG	11/3/1999	CHROMIUM	29.7		mg/kg
99RC-MW02-S-1-10	REG	11/9/1999	CHROMIUM	28.7		mg/kg
00RC-DP10-S-1-10	REG	1/26/2000	CHROMIUM	28.3		mg/kg
99RC-DP04-S-1-05	REG	11/3/1999	CHROMIUM	28.2		mg/kg
00RC-DP09-S-1-25	REG	1/24/2000	CHROMIUM	27.9		mg/kg
99RC-DP01-S-3-20	DUP	11/3/1999	CHROMIUM	27.4		mg/kg
99RC-DP02-S-1-18	REG	11/2/1999	CHROMIUM	27.4		mg/kg
00RC-DP11-S-1-16	REG	1/26/2000	CHROMIUM	26.9		mg/kg
99RC-DP04-S-1-12	DUP	11/3/1999	CHROMIUM	26.8		mg/kg
99RC-DP01-S-1-15	REG	11/3/1999	CHROMIUM	26.7		mg/kg
99RC-DP02-S-1-12	REG	11/2/1999	CHROMIUM	26.3		mg/kg
99RC-MW02-S-1-05	REG	11/9/1999	CHROMIUM	26.3		mg/kg
99RC-MW01-S-1-10	REG	11/1/1999	CHROMIUM	26.2		mg/kg
99RC-DP02-S-1-05	REG	11/2/1999	CHROMIUM	26.1		mg/kg
99RC-DP01-S-1-05	REG	11/3/1999	CHROMIUM	25.8		mg/kg
99RC-DP03-S-1-18	REG	11/2/1999	CHROMIUM	25.7		mg/kg
00RC-MW07-S-1-05	REG	1/24/2000	CHROMIUM	25.5		mg/kg
99RC-DP03-S-1-12	REG	11/1/1999	CHROMIUM	25.5		mg/kg
99RC-MW02-S-1-26	REG	11/9/1999	CHROMIUM	25.4		mg/kg
99RC-DP07-S-1-21	REG	11/2/1999	CHROMIUM	25.3		mg/kg
99RC-DP01-S-1-20	REG	11/3/1999	CHROMIUM	25.1		mg/kg
99RC-MW03-S-1-15	REG	11/4/1999	CHROMIUM	25		mg/kg
99RC-DP03-S-1-05	REG	11/1/1999	CHROMIUM	24.7		mg/kg
99RC-MW01-S-1-20	REG	11/1/1999	CHROMIUM	24.7		mg/kg
00RC-DP11-S-1-10	REG	1/26/2000	CHROMIUM	24.5		mg/kg
99RC-MW05-S-1-10	REG	11/5/1999	CHROMIUM	24.5		mg/kg
99RC-DP07-S-1-05	REG	11/2/1999	CHROMIUM	24.3		mg/kg
99RC-MW01-S-1-05	REG	11/1/1999	CHROMIUM	24.3		mg/kg
99RC-MW03-S-1-10	REG	11/4/1999	CHROMIUM	24.3		mg/kg
00RC-DP11-S-1-5	REG	1/26/2000	CHROMIUM	23.5		mg/kg
99RC-MW03-S-1-20	REG	11/4/1999	CHROMIUM	23.5		mg/kg
00RC-DP09-S-1-5	REG	1/24/2000	CHROMIUM	23.2		mg/kg
99RC-DP05-S-1-12	REG	11/3/1999	CHROMIUM	23.2		mg/kg
99RC-DP07-S-1-10	REG	11/2/1999	CHROMIUM	22.8		mg/kg
00RC-DP10-S-1-5	REG	1/26/2000	CHROMIUM	22.4		mg/kg
99RC-DP06-S-1-11	REG	11/4/1999	CHROMIUM	22.4		mg/kg
99RC-DP04-S-1-18	DUP	11/3/1999	CHROMIUM	22.2		mg/kg
99RC-MW05-S-1-15	REG	11/5/1999	CHROMIUM	22.1		mg/kg
99RC-MW05-S-3-15	DUP	11/5/1999	CHROMIUM	22.1		mg/kg
99RC-DP03-S-1-25	REG	11/2/1999	CHROMIUM	22		mg/kg
99RC-MW02-S-1-21	REG	11/9/1999	CHROMIUM	21.7		mg/kg
99RC-MW01-S-1-25	REG	11/1/1999	CHROMIUM	21.4		mg/kg
00RC-DP09-S-1-19	REG	1/24/2000	CHROMIUM	21.3		mg/kg
00RC-MW07-S-1-25	REG	1/24/2000	CHROMIUM	21.1		mg/kg
99RC-MW05-S-1-26	REG	11/5/1999	CHROMIUM	21.1		mg/kg

00RC-DP09-S-1-12	REG	1/24/2000 CHROMIUM	20.9	mg/kg
99RC-DP02-S-1-25	REG	11/2/1999 CHROMIUM	20.9	mg/kg
99RC-DP07-S-1-16	REG	11/2/1999 CHROMIUM	20.9	mg/kg
00RC-DP08-S-1-24	REG	1/25/2000 CHROMIUM	20.6	mg/kg
00RC-MW07-S-1-19	REG	1/24/2000 CHROMIUM	20.3	mg/kg
99RC-MW03-S-3-15	DUP	11/4/1999 CHROMIUM	20.1	mg/kg
00RC-DP08-S-3-24	DUP	1/25/2000 CHROMIUM	20	mg/kg
99RC-DP05-S-1-25	REG	11/3/1999 CHROMIUM	19.8	mg/kg
00RC-MW06-S-1-10	REG	1/25/2000 CHROMIUM	19.7	mg/kg
99RC-DP04-S-1-25	DUP	11/3/1999 CHROMIUM	19.7	mg/kg
99RC-DP05-S-1-18	REG	11/3/1999 CHROMIUM	19.7	mg/kg
00RC-MW07-S-1-12	REG	1/24/2000 CHROMIUM	19.6	mg/kg
99RC-MW04-S-3-15	DUP	11/8/1999 CHROMIUM	19.6	mg/kg
99RC-MW05-S-1-21	REG	11/5/1999 CHROMIUM	19.5	mg/kg
00RC-DP08-S-1-12	REG	1/25/2000 CHROMIUM	19.3	mg/kg
99RC-MW04-S-1-20	REG	11/8/1999 CHROMIUM	19.1	mg/kg
00RC-DP08-S-1-18	REG	1/25/2000 CHROMIUM	18.5	mg/kg
00RC-DP10-S-1-23	REG	1/26/2000 CHROMIUM	18.5	mg/kg
99RC-DP06-S-1-05	REG	11/4/1999 CHROMIUM	18.5	mg/kg
00RC-DP11-S-1-24	REG	1/26/2000 CHROMIUM	18.1	mg/kg
99RC-DP01-S-1-25	REG	11/3/1999 CHROMIUM	18.1	mg/kg
99RC-MW04-S-1-15	REG	11/8/1999 CHROMIUM	17.6	mg/kg
00RC-DP08-S-1-5	REG	1/25/2000 CHROMIUM	16.9	mg/kg
99RC-MW03-S-1-26	REG	11/4/1999 CHROMIUM	16.8	mg/kg
00RC-MW06-S-1-5	REG	1/25/2000 CHROMIUM	16.3	mg/kg
99RC-MW04-S-1-10	REG	11/8/1999 CHROMIUM	15.8	mg/kg
00RC-MW06-S-1-20	REG	1/25/2000 CHROMIUM	15.5	mg/kg
99RC-MW04-S-1-05	REG	11/8/1999 CHROMIUM	15	mg/kg
00RC-DP10-S-1-17	REG	1/26/2000 CHROMIUM	14.6	mg/kg
99RC-DP06-S-1-20	REG	11/4/1999 CHROMIUM	13.1	mg/kg
00RC-DP11-S-3-24	DUP	1/26/2000 CHROMIUM	12.8	mg/kg
00RC-MW06-S-1-15	REG	1/25/2000 CHROMIUM	9.1 J	mg/kg
00RC-MW06-S-3-15	DUP	1/25/2000 CHROMIUM	5.6 J	mg/kg
99RC-DP06-S-1-16	REG	11/4/1999 CHROMIUM	4.5	mg/kg

SAMPLE ID NUMBER	TYPE	SAMPLE DATE	ANALYTE	RESULT	Qualifier	UNIT
99RC-DP01-S-1-10	REG	11/3/1999	IRON	34600		mg/kg
00RC-DP11-S-1-16	REG	1/26/2000	IRON	33700		mg/kg
99RC-DP02-S-1-18	REG	11/2/1999	IRON	31700		mg/kg
00RC-DP11-S-1-10	REG	1/26/2000	IRON	30800		mg/kg
00RC-DP10-S-1-10	REG	1/26/2000	IRON	30500		mg/kg
99RC-MW03-S-1-15	REG	11/4/1999	IRON	30100		mg/kg
99RC-DP02-S-1-12	REG	11/2/1999	IRON	29900		mg/kg
99RC-MW02-S-1-10	REG	11/9/1999	IRON	29800		mg/kg
99RC-MW03-S-1-10	REG	11/4/1999	IRON	29700		mg/kg
99RC-MW03-S-1-20	REG	11/4/1999	IRON	29600		mg/kg
99RC-DP03-S-3-18	DUP	11/2/1999	IRON	29500		mg/kg
99RC-DP05-S-1-05	REG	11/3/1999	IRON	29400		mg/kg
00RC-DP11-S-1-5	REG	1/26/2000	IRON	29300		mg/kg
99RC-DP01-S-3-20	DUP	11/3/1999	IRON	29000		mg/kg
00RC-DP08-S-3-24	DUP	1/25/2000	IRON	28900		mg/kg
99RC-MW01-S-1-10	REG	11/1/1999	IRON	28900		mg/kg
99RC-MW02-S-1-05	REG	11/9/1999	IRON	28900		mg/kg
99RC-DP05-S-1-12	REG	11/3/1999	IRON	28500		mg/kg
99RC-DP02-S-1-05	REG	11/2/1999	IRON	28400		mg/kg
00RC-MW07-S-1-05	REG	1/24/2000	IRON	28100		mg/kg
99RC-DP04-S-1-05	REG	11/3/1999	IRON	27900		mg/kg
99RC-MW04-S-1-20	REG	11/8/1999	IRON	27800		mg/kg
99RC-DP04-S-1-25	DUP	11/3/1999	IRON	27700		mg/kg
00RC-DP08-S-1-18	REG	1/25/2000	IRON	27600		mg/kg
99RC-DP03-S-1-12	REG	11/1/1999	IRON	27500		mg/kg
00RC-DP10-S-1-5	REG	1/26/2000	IRON	27200		mg/kg
00RC-MW06-S-1-10	REG	1/25/2000	IRON	27200		mg/kg
99RC-MW01-S-1-05	REG	11/1/1999	IRON	27200		mg/kg
99RC-DP01-S-1-15	REG	11/3/1999	IRON	27100		mg/kg
00RC-DP11-S-1-24	REG	1/26/2000	IRON	27000	J	mg/kg
99RC-MW02-S-1-26	REG	11/9/1999	IRON	26700		mg/kg
00RC-DP08-S-1-24	REG	1/25/2000	IRON	26600		mg/kg
99RC-MW02-S-1-21	REG	11/9/1999	IRON	26600		mg/kg
00RC-DP09-S-1-19	REG	1/24/2000	IRON	26500		mg/kg
99RC-DP05-S-3-05	DUP	11/3/1999	IRON	26500		mg/kg
99RC-MW05-S-1-26	REG	11/5/1999	IRON	26500		mg/kg
99RC-MW01-S-1-25	REG	11/1/1999	IRON	26400		mg/kg
00RC-DP10-S-1-23	REG	1/26/2000	IRON	26300		mg/kg
00RC-DP08-S-1-12	REG	1/25/2000	IRON	26200		mg/kg
99RC-DP03-S-1-18	REG	11/2/1999	IRON	26100		mg/kg
99RC-DP04-S-1-12	DUP	11/3/1999	IRON	26100		mg/kg
99RC-DP06-S-1-11	REG	11/4/1999	IRON	26100		mg/kg
00RC-DP09-S-1-12	REG	1/24/2000	IRON	25800		mg/kg
99RC-DP07-S-1-21	REG	11/2/1999	IRON	25600		mg/kg
00RC-DP09-S-1-5	REG	1/24/2000	IRON	25500		mg/kg
99RC-DP05-S-1-18	REG	11/3/1999	IRON	25500		mg/kg
99RC-DP05-S-1-25	REG	11/3/1999	IRON	25400		mg/kg
00RC-MW07-S-1-19	REG	1/24/2000	IRON	25100		mg/kg

99RC-DP01-S-1-05	REG	11/3/1999 IRON	25100	mg/kg
99RC-DP07-S-1-05	REG	11/2/1999 IRON	25100	mg/kg
99RC-MW05-S-1-10	REG	11/5/1999 IRON	25100	mg/kg
00RC-MW07-S-1-12	REG	1/24/2000 IRON	24900	mg/kg
99RC-DP03-S-1-05	REG	11/1/1999 IRON	24900	mg/kg
99RC-MW01-S-1-20	REG	11/1/1999 IRON	24800	mg/kg
00RC-MW07-S-1-25	REG	1/24/2000 IRON	24700	mg/kg
99RC-MW04-S-3-15	DUP	11/8/1999 IRON	24700	mg/kg
00RC-DP09-S-1-25	REG	1/24/2000 IRON	24600	mg/kg
99RC-DP01-S-1-20	REG	11/3/1999 IRON	24600	mg/kg
99RC-DP03-S-1-25	REG	11/2/1999 IRON	24100	mg/kg
99RC-DP04-S-1-18	DUP	11/3/1999 IRON	23600	mg/kg
99RC-MW04-S-1-10	REG	11/8/1999 IRON	23300	mg/kg
99RC-MW03-S-3-15	DUP	11/4/1999 IRON	23000	mg/kg
99RC-DP02-S-1-25	REG	11/2/1999 IRON	22600	mg/kg
99RC-MW04-S-1-15	REG	11/8/1999 IRON	21700	mg/kg
99RC-DP01-S-1-25	REG	11/3/1999 IRON	21200	mg/kg
99RC-DP06-S-1-05	REG	11/4/1999 IRON	20900	mg/kg
99RC-DP06-S-1-20	REG	11/4/1999 IRON	20800	mg/kg
99RC-MW04-S-1-05	REG	11/8/1999 IRON	20800	mg/kg
99RC-DP07-S-1-16	REG	11/2/1999 IRON	20500	mg/kg
00RC-DP10-S-1-17	REG	1/26/2000 IRON	20400	mg/kg
00RC-DP08-S-1-5	REG	1/25/2000 IRON	19800	mg/kg
99RC-MW03-S-1-26	REG	11/4/1999 IRON	19700	mg/kg
99RC-MW05-S-3-15	DUP	11/5/1999 IRON	19400	mg/kg
99RC-MW05-S-1-15	REG	11/5/1999 IRON	19000	mg/kg
00RC-MW06-S-1-5	REG	1/25/2000 IRON	18600	mg/kg
00RC-DP11-S-3-24	DUP	1/26/2000 IRON	17700 J	mg/kg
99RC-DP07-S-1-10	REG	11/2/1999 IRON	17600	mg/kg
99RC-MW05-S-1-21	REG	11/5/1999 IRON	17200	mg/kg
00RC-MW06-S-1-20	REG	1/25/2000 IRON	17000	mg/kg
00RC-MW06-S-1-15	REG	1/25/2000 IRON	7840 J	mg/kg
99RC-DP06-S-1-16	REG	11/4/1999 IRON	6120	mg/kg
00RC-MW06-S-3-15	DUP	1/25/2000 IRON	5250 J	mg/kg

SAMPLE ID NUMBER	TYPE	SAMPLE DATE	ANALYTE	RESULT	Qualifier	UNIT
00RC-MW06-S-1-5	REG	1/25/2000	LEAD	37		mg/kg
99RC-MW05-S-1-10	REG	11/5/1999	LEAD	23.1	J	mg/kg
99RC-DP05-S-3-05	DUP	11/3/1999	LEAD	17.4	J	mg/kg
99RC-DP04-S-1-05	REG	11/3/1999	LEAD	17.2		mg/kg
99RC-DP06-S-1-05	REG	11/4/1999	LEAD	17	J	mg/kg
99RC-MW01-S-1-05	REG	11/1/1999	LEAD	11.8		mg/kg
99RC-DP01-S-1-10	REG	11/3/1999	LEAD	9.9		mg/kg
00RC-DP11-S-1-16	REG	1/26/2000	LEAD	9.4		mg/kg
99RC-DP01-S-3-20	DUP	11/3/1999	LEAD	9.1		mg/kg
99RC-MW01-S-1-10	REG	11/1/1999	LEAD	9.1		mg/kg
99RC-MW01-S-1-25	REG	11/1/1999	LEAD	8.7		mg/kg
99RC-DP06-S-1-11	REG	11/4/1999	LEAD	8.4	J	mg/kg
99RC-MW02-S-1-26	REG	11/9/1999	LEAD	8.3		mg/kg
00RC-DP11-S-1-24	REG	1/26/2000	LEAD	8	J	mg/kg
99RC-DP05-S-1-12	REG	11/3/1999	LEAD	8		mg/kg
99RC-MW03-S-1-10	REG	11/4/1999	LEAD	8	J	mg/kg
00RC-DP09-S-1-19	REG	1/24/2000	LEAD	7.9		mg/kg
99RC-DP05-S-1-05	REG	11/3/1999	LEAD	7.8	J	mg/kg
00RC-DP11-S-1-5	REG	1/26/2000	LEAD	7.7		mg/kg
99RC-MW03-S-1-20	REG	11/4/1999	LEAD	7.7	J	mg/kg
00RC-DP11-S-1-10	REG	1/26/2000	LEAD	7.6		mg/kg
99RC-DP01-S-1-20	REG	11/3/1999	LEAD	7.6		mg/kg
00RC-MW07-S-1-25	REG	1/24/2000	LEAD	7.5		mg/kg
99RC-MW01-S-1-20	REG	11/1/1999	LEAD	7.5		mg/kg
99RC-MW03-S-3-15	DUP	11/4/1999	LEAD	7.4	J	mg/kg
00RC-DP08-S-3-24	DUP	1/25/2000	LEAD	7.2	J	mg/kg
00RC-DP10-S-1-10	REG	1/26/2000	LEAD	7.2		mg/kg
99RC-DP01-S-1-15	REG	11/3/1999	LEAD	7.2		mg/kg
99RC-DP03-S-1-18	REG	11/2/1999	LEAD	7.2		mg/kg
99RC-DP03-S-3-18	DUP	11/2/1999	LEAD	7.2		mg/kg
99RC-MW05-S-1-15	REG	11/5/1999	LEAD	7	J	mg/kg
00RC-DP08-S-1-12	REG	1/25/2000	LEAD	6.8		mg/kg
00RC-MW07-S-1-19	REG	1/24/2000	LEAD	6.8		mg/kg
99RC-MW03-S-1-15	REG	11/4/1999	LEAD	6.8	J	mg/kg
99RC-DP02-S-1-18	REG	11/2/1999	LEAD	6.7		mg/kg
00RC-DP08-S-1-5	REG	1/25/2000	LEAD	6.6		mg/kg
00RC-DP09-S-1-5	REG	1/24/2000	LEAD	6.5		mg/kg
99RC-DP04-S-1-12	DUP	11/3/1999	LEAD	6.5		mg/kg
99RC-MW02-S-1-05	REG	11/9/1999	LEAD	6.5		mg/kg
99RC-MW02-S-1-10	REG	11/9/1999	LEAD	6.5		mg/kg
99RC-DP07-S-1-21	REG	11/2/1999	LEAD	6.4		mg/kg
99RC-MW05-S-1-26	REG	11/5/1999	LEAD	6.4	J	mg/kg
99RC-DP01-S-1-25	REG	11/3/1999	LEAD	6.3		mg/kg
99RC-DP02-S-1-05	REG	11/2/1999	LEAD	6.3		mg/kg
99RC-DP02-S-1-12	REG	11/2/1999	LEAD	6.3		mg/kg
99RC-DP03-S-1-05	REG	11/1/1999	LEAD	6.3		mg/kg
99RC-MW05-S-3-15	DUP	11/5/1999	LEAD	6.3	J	mg/kg
00RC-MW07-S-1-12	REG	1/24/2000	LEAD	6.2		mg/kg

99RC-DP07-S-1-05	REG	11/2/1999 LEAD	6.2	mg/kg
00RC-DP08-S-1-18	REG	1/25/2000 LEAD	6.1	mg/kg
99RC-DP02-S-1-25	REG	11/2/1999 LEAD	6.1	mg/kg
00RC-MW06-S-1-20	REG	1/25/2000 LEAD	6	mg/kg
00RC-MW06-S-1-10	REG	1/25/2000 LEAD	5.9	mg/kg
99RC-DP01-S-1-05	REG	11/3/1999 LEAD	5.9	mg/kg
99RC-DP03-S-1-25	REG	11/2/1999 LEAD	5.9	mg/kg
99RC-DP07-S-1-16	REG	11/2/1999 LEAD	5.9	mg/kg
99RC-MW04-S-1-15	REG	11/8/1999 LEAD	5.9 J	mg/kg
99RC-MW02-S-1-21	REG	11/9/1999 LEAD	5.7	mg/kg
99RC-MW04-S-3-15	DUP	11/8/1999 LEAD	5.7 J	mg/kg
00RC-DP09-S-1-25	REG	1/24/2000 LEAD	5.6	mg/kg
99RC-DP03-S-1-12	REG	11/1/1999 LEAD	5.5	mg/kg
99RC-MW04-S-1-10	REG	11/8/1999 LEAD	5.5 J	mg/kg
99RC-DP07-S-1-10	REG	11/2/1999 LEAD	5.4	mg/kg
99RC-MW04-S-1-20	REG	11/8/1999 LEAD	5.3 J	mg/kg
00RC-DP10-S-1-5	REG	1/26/2000 LEAD	5.2	mg/kg
99RC-DP04-S-1-18	DUP	11/3/1999 LEAD	5.1	mg/kg
99RC-DP04-S-1-25	DUP	11/3/1999 LEAD	5.1	mg/kg
00RC-DP11-S-3-24	DUP	1/26/2000 LEAD	5 J	mg/kg
00RC-MW07-S-1-05	REG	1/24/2000 LEAD	4.9	mg/kg
99RC-MW04-S-1-05	REG	11/8/1999 LEAD	4.9 J	mg/kg
99RC-DP05-S-1-25	REG	11/3/1999 LEAD	4.8	mg/kg
00RC-DP10-S-1-17	REG	1/26/2000 LEAD	4.2	mg/kg
99RC-MW05-S-1-21	REG	11/5/1999 LEAD	4.2 J	mg/kg
99RC-DP05-S-1-18	REG	11/3/1999 LEAD	4.1	mg/kg
00RC-DP10-S-1-23	REG	1/26/2000 LEAD	3.7	mg/kg
00RC-DP09-S-1-12	REG	1/24/2000 LEAD	3.6	mg/kg
00RC-DP08-S-1-24	REG	1/25/2000 LEAD	3.2 J	mg/kg
99RC-MW03-S-1-26	REG	11/4/1999 LEAD	3 J	mg/kg
00RC-MW06-S-1-15	REG	1/25/2000 LEAD	2.8 J	mg/kg
99RC-DP06-S-1-20	REG	11/4/1999 LEAD	2.7 J	mg/kg
99RC-DP06-S-1-16	REG	11/4/1999 LEAD	2.4 UJ	mg/kg
00RC-MW06-S-3-15	DUP	1/25/2000 LEAD	1.8 UJ	mg/kg

SAMPLE ID NUMBER	TYPE	SAMPLE DATE	ANALYTE	RESULT	Qualifier	UNIT
99RC-MW05-S-1-10	REG	11/5/1999	MERCURY	0.15	J	mg/kg
99RC-MW02-S-1-21	REG	11/9/1999	MERCURY	0.13	J	mg/kg
00RC-MW06-S-1-5	REG	1/25/2000	MERCURY	0.12	J	mg/kg
99RC-MW02-S-1-10	REG	11/9/1999	MERCURY	0.12	J	mg/kg
99RC-MW02-S-1-05	REG	11/9/1999	MERCURY	0.11	J	mg/kg
99RC-MW02-S-1-26	REG	11/9/1999	MERCURY	0.11	J	mg/kg
99RC-MW05-S-1-21	REG	11/5/1999	MERCURY	0.094	J	mg/kg
99RC-DP07-S-1-16	REG	11/2/1999	MERCURY	0.076	J	mg/kg
99RC-MW05-S-3-15	DUP	11/5/1999	MERCURY	0.075	J	mg/kg
99RC-MW05-S-1-15	REG	11/5/1999	MERCURY	0.057	J	mg/kg
99RC-DP05-S-3-05	DUP	11/3/1999	MERCURY	0.056	J	mg/kg
99RC-DP06-S-1-20	REG	11/4/1999	MERCURY	0.056	J	mg/kg
00RC-MW07-S-1-12	REG	1/24/2000	MERCURY	0.055	J	mg/kg
00RC-DP10-S-1-17	REG	1/26/2000	MERCURY	0.053	U	mg/kg
00RC-MW06-S-1-20	REG	1/25/2000	MERCURY	0.05	J	mg/kg
99RC-DP07-S-1-10	REG	11/2/1999	MERCURY	0.047	J	mg/kg
99RC-MW05-S-1-26	REG	11/5/1999	MERCURY	0.045	J	mg/kg
00RC-MW07-S-1-05	REG	1/24/2000	MERCURY	0.042	J	mg/kg
99RC-DP06-S-1-11	REG	11/4/1999	MERCURY	0.038	J	mg/kg
99RC-MW04-S-1-20	REG	11/8/1999	MERCURY	0.037	J	mg/kg
00RC-DP10-S-1-5	REG	1/26/2000	MERCURY	0.036	U	mg/kg
99RC-DP03-S-1-18	REG	11/2/1999	MERCURY	0.036	J	mg/kg
99RC-DP04-S-1-05	REG	11/3/1999	MERCURY	0.036	J	mg/kg
99RC-MW03-S-1-26	REG	11/4/1999	MERCURY	0.036	J	mg/kg
99RC-MW04-S-1-15	REG	11/8/1999	MERCURY	0.036	J	mg/kg
99RC-DP02-S-1-18	REG	11/2/1999	MERCURY	0.034	J	mg/kg
00RC-DP09-S-1-25	REG	1/24/2000	MERCURY	0.033	J	mg/kg
99RC-DP01-S-1-25	REG	11/3/1999	MERCURY	0.031	J	mg/kg
00RC-DP09-S-1-19	REG	1/24/2000	MERCURY	0.029	J	mg/kg
00RC-MW07-S-1-25	REG	1/24/2000	MERCURY	0.028	J	mg/kg
99RC-DP04-S-1-25	DUP	11/3/1999	MERCURY	0.028	J	mg/kg
99RC-DP01-S-1-20	REG	11/3/1999	MERCURY	0.027	J	mg/kg
99RC-MW03-S-1-20	REG	11/4/1999	MERCURY	0.027	J	mg/kg
99RC-DP01-S-3-20	DUP	11/3/1999	MERCURY	0.026	J	mg/kg
99RC-DP02-S-1-25	REG	11/2/1999	MERCURY	0.026	J	mg/kg
00RC-DP11-S-1-16	REG	1/26/2000	MERCURY	0.025	U	mg/kg
00RC-DP09-S-1-12	REG	1/24/2000	MERCURY	0.024	J	mg/kg
00RC-DP09-S-1-5	REG	1/24/2000	MERCURY	0.024	J	mg/kg
00RC-DP10-S-1-23	REG	1/26/2000	MERCURY	0.024	U	mg/kg
99RC-DP02-S-1-05	REG	11/2/1999	MERCURY	0.024	J	mg/kg
99RC-DP05-S-1-25	REG	11/3/1999	MERCURY	0.023	J	mg/kg
00RC-DP08-S-1-18	REG	1/25/2000	MERCURY	0.022	J	mg/kg
99RC-DP04-S-1-12	DUP	11/3/1999	MERCURY	0.022	J	mg/kg
99RC-DP07-S-1-05	REG	11/2/1999	MERCURY	0.022	J	mg/kg
00RC-DP10-S-1-10	REG	1/26/2000	MERCURY	0.021	U	mg/kg
99RC-DP01-S-1-05	REG	11/3/1999	MERCURY	0.021	J	mg/kg
99RC-DP05-S-1-12	REG	11/3/1999	MERCURY	0.019	J	mg/kg
99RC-DP05-S-1-18	REG	11/3/1999	MERCURY	0.019	J	mg/kg

99RC-DP05-S-1-05	REG	11/3/1999 MERCURY	0.018 J	mg/kg
99RC-DP01-S-1-10	REG	11/3/1999 MERCURY	0.014 J	mg/kg
99RC-DP06-S-1-05	REG	11/4/1999 MERCURY	0.014 J	mg/kg
99RC-MW03-S-3-15	DUP	11/4/1999 MERCURY	0.012 J	mg/kg
99RC-DP01-S-1-15	REG	11/3/1999 MERCURY	0.011 J	mg/kg
99RC-MW03-S-1-10	REG	11/4/1999 MERCURY	0.011 J	mg/kg
99RC-DP04-S-1-18	DUP	11/3/1999 MERCURY	0.01 J	mg/kg
00RC-DP08-S-1-12	REG	1/25/2000 MERCURY	U	mg/kg
00RC-DP08-S-1-24	REG	1/25/2000 MERCURY	U	mg/kg
00RC-DP08-S-1-5	REG	1/25/2000 MERCURY	U	mg/kg
00RC-DP08-S-3-24	DUP	1/25/2000 MERCURY	U	mg/kg
00RC-DP11-S-1-10	REG	1/26/2000 MERCURY	U	mg/kg
00RC-DP11-S-1-24	REG	1/26/2000 MERCURY	U	mg/kg
00RC-DP11-S-1-5	REG	1/26/2000 MERCURY	U	mg/kg
00RC-DP11-S-3-24	DUP	1/26/2000 MERCURY	U	mg/kg
00RC-MW06-S-1-10	REG	1/25/2000 MERCURY	U	mg/kg
00RC-MW06-S-1-15	REG	1/25/2000 MERCURY	U	mg/kg
00RC-MW06-S-3-15	DUP	1/25/2000 MERCURY	U	mg/kg
00RC-MW07-S-1-19	REG	1/24/2000 MERCURY	U	mg/kg
99RC-DP02-S-1-12	REG	11/2/1999 MERCURY	U	mg/kg
99RC-DP03-S-1-05	REG	11/1/1999 MERCURY	U	mg/kg
99RC-DP03-S-1-12	REG	11/1/1999 MERCURY	U	mg/kg
99RC-DP03-S-1-25	REG	11/2/1999 MERCURY	U	mg/kg
99RC-DP03-S-3-18	DUP	11/2/1999 MERCURY	UJ	mg/kg
99RC-DP06-S-1-16	REG	11/4/1999 MERCURY	U	mg/kg
99RC-DP07-S-1-21	REG	11/2/1999 MERCURY	U	mg/kg
99RC-MW01-S-1-05	REG	11/1/1999 MERCURY	U	mg/kg
99RC-MW01-S-1-10	REG	11/1/1999 MERCURY	U	mg/kg
99RC-MW01-S-1-20	REG	11/1/1999 MERCURY	U	mg/kg
99RC-MW01-S-1-25	REG	11/1/1999 MERCURY	U	mg/kg
99RC-MW03-S-1-15	REG	11/4/1999 MERCURY	UJ	mg/kg
99RC-MW04-S-1-05	REG	11/8/1999 MERCURY	U	mg/kg
99RC-MW04-S-1-10	REG	11/8/1999 MERCURY	U	mg/kg
99RC-MW04-S-3-15	DUP	11/8/1999 MERCURY	UJ	mg/kg

SAMPLE ID NUMBER	TYPE	SAMPLE DATE	ANALYTE	RESULT	Qualifier	UNIT
00RC-MW07-S-1-25	REG	1/24/2000	MOLYBDENUM	6.1		mg/kg
99RC-DP04-S-1-05	REG	11/3/1999	MOLYBDENUM	5.5		mg/kg
00RC-DP11-S-1-24	REG	1/26/2000	MOLYBDENUM	3.8	UJ	mg/kg
99RC-DP05-S-3-05	DUP	11/3/1999	MOLYBDENUM	3.7	J	mg/kg
99RC-MW01-S-1-25	REG	11/1/1999	MOLYBDENUM	3.6		mg/kg
99RC-DP01-S-3-20	DUP	11/3/1999	MOLYBDENUM	3.4		mg/kg
00RC-MW07-S-1-19	REG	1/24/2000	MOLYBDENUM	3.3	U	mg/kg
99RC-DP01-S-1-25	REG	11/3/1999	MOLYBDENUM	3.1		mg/kg
99RC-DP02-S-1-12	REG	11/2/1999	MOLYBDENUM	2.8		mg/kg
99RC-MW01-S-1-10	REG	11/1/1999	MOLYBDENUM	2.8		mg/kg
99RC-MW03-S-1-15	REG	11/4/1999	MOLYBDENUM	2.8	J	mg/kg
99RC-MW05-S-1-26	REG	11/5/1999	MOLYBDENUM	2.8		mg/kg
00RC-DP08-S-3-24	DUP	1/25/2000	MOLYBDENUM	2.7	J	mg/kg
99RC-DP01-S-1-20	REG	11/3/1999	MOLYBDENUM	2.7		mg/kg
99RC-DP03-S-3-18	DUP	11/2/1999	MOLYBDENUM	2.7	J	mg/kg
99RC-DP02-S-1-18	REG	11/2/1999	MOLYBDENUM	2.6		mg/kg
00RC-DP11-S-3-24	DUP	1/26/2000	MOLYBDENUM	2.5	UJ	mg/kg
00RC-DP11-S-1-16	REG	1/26/2000	MOLYBDENUM	2.4		mg/kg
99RC-MW01-S-1-20	REG	11/1/1999	MOLYBDENUM	2.4		mg/kg
00RC-DP09-S-1-12	REG	1/24/2000	MOLYBDENUM	2.3	U	mg/kg
00RC-DP10-S-1-10	REG	1/26/2000	MOLYBDENUM	2.3		mg/kg
99RC-DP02-S-1-25	REG	11/2/1999	MOLYBDENUM	2.3		mg/kg
99RC-DP03-S-1-25	REG	11/2/1999	MOLYBDENUM	2.3		mg/kg
99RC-DP04-S-1-12	DUP	11/3/1999	MOLYBDENUM	2.3		mg/kg
99RC-MW03-S-1-20	REG	11/4/1999	MOLYBDENUM	2.3		mg/kg
99RC-MW02-S-1-26	REG	11/9/1999	MOLYBDENUM	2.2		mg/kg
00RC-DP08-S-1-18	REG	1/25/2000	MOLYBDENUM	2.1		mg/kg
00RC-DP11-S-1-10	REG	1/26/2000	MOLYBDENUM	2.1		mg/kg
99RC-DP05-S-1-05	REG	11/3/1999	MOLYBDENUM	2.1	J	mg/kg
99RC-MW03-S-1-26	REG	11/4/1999	MOLYBDENUM	2.1		mg/kg
00RC-DP09-S-1-25	REG	1/24/2000	MOLYBDENUM	2	U	mg/kg
99RC-DP01-S-1-10	REG	11/3/1999	MOLYBDENUM	1.9		mg/kg
99RC-MW03-S-3-15	DUP	11/4/1999	MOLYBDENUM	1.8	J	mg/kg
99RC-MW02-S-1-10	REG	11/9/1999	MOLYBDENUM	1.7	U	mg/kg
00RC-DP08-S-1-5	REG	1/25/2000	MOLYBDENUM	1.5	U	mg/kg
00RC-DP10-S-1-17	REG	1/26/2000	MOLYBDENUM	1.5	U	mg/kg
00RC-DP10-S-1-23	REG	1/26/2000	MOLYBDENUM	1.4	U	mg/kg
99RC-DP05-S-1-12	REG	11/3/1999	MOLYBDENUM	1.4		mg/kg
99RC-DP03-S-1-18	REG	11/2/1999	MOLYBDENUM	1.3	J	mg/kg
00RC-MW06-S-1-5	REG	1/25/2000	MOLYBDENUM	1.2		mg/kg
00RC-MW07-S-1-05	REG	1/24/2000	MOLYBDENUM	1.1	U	mg/kg
99RC-DP04-S-1-18	DUP	11/3/1999	MOLYBDENUM	1.1	U	mg/kg
99RC-DP06-S-1-05	REG	11/4/1999	MOLYBDENUM	1.1	U	mg/kg
99RC-MW02-S-1-21	REG	11/9/1999	MOLYBDENUM	1.1	U	mg/kg
99RC-DP06-S-1-11	REG	11/4/1999	MOLYBDENUM	1	U	mg/kg
99RC-MW05-S-1-10	REG	11/5/1999	MOLYBDENUM	0.9	U	mg/kg
99RC-MW04-S-1-15	REG	11/8/1999	MOLYBDENUM	0.88	UJ	mg/kg
99RC-DP01-S-1-15	REG	11/3/1999	MOLYBDENUM	0.87	U	mg/kg

99RC-DP03-S-1-12	REG	11/1/1999 MOLYBDENUM	0 81 U	mg/kg
99RC-DP05-S-1-25	REG	11/3/1999 MOLYBDENUM	0 8 U	mg/kg
99RC-DP06-S-1-20	REG	11/4/1999 MOLYBDENUM	0 79	mg/kg
99RC-MW05-S-3-15	DUP	11/5/1999 MOLYBDENUM	0 74 U	mg/kg
00RC-DP09-S-1-19	REG	1/24/2000 MOLYBDENUM	0 71 U	mg/kg
99RC-MW02-S-1-05	REG	11/9/1999 MOLYBDENUM	0 71 U	mg/kg
00RC-DP08-S-1-24	REG	1/25/2000 MOLYBDENUM	0 61 UJ	mg/kg
00RC-MW07-S-1-12	REG	1/24/2000 MOLYBDENUM	0 56 U	mg/kg
99RC-MW05-S-1-15	REG	11/5/1999 MOLYBDENUM	0 56 U	mg/kg
00RC-DP08-S-1-12	REG	1/25/2000 MOLYBDENUM	0 55 U	mg/kg
99RC-MW04-S-1-05	REG	11/8/1999 MOLYBDENUM	0 55 U	mg/kg
00RC-MW06-S-1-20	REG	1/25/2000 MOLYBDENUM	0 43 U	mg/kg
99RC-DP04-S-1-25	DUP	11/3/1999 MOLYBDENUM	0 29 U	mg/kg
99RC-DP03-S-1-05	REG	11/1/1999 MOLYBDENUM	0 26 U	mg/kg
99RC-MW05-S-1-21	REG	11/5/1999 MOLYBDENUM	0 26 U	mg/kg
99RC-DP06-S-1-16	REG	11/4/1999 MOLYBDENUM	0 24 U	mg/kg
99RC-MW03-S-1-10	REG	11/4/1999 MOLYBDENUM	0 24 U	mg/kg
00RC-DP09-S-1-5	REG	1/24/2000 MOLYBDENUM	0 19 U	mg/kg
00RC-MW06-S-1-15	REG	1/25/2000 MOLYBDENUM	0 16 UJ	mg/kg
00RC-DP10-S-1-5	REG	1/26/2000 MOLYBDENUM	0 14 U	mg/kg
00RC-MW06-S-3-15	DUP	1/25/2000 MOLYBDENUM	0 071 UJ	mg/kg
00RC-DP11-S-1-5	REG	1/26/2000 MOLYBDENUM	U	mg/kg
00RC-MW06-S-1-10	REG	1/25/2000 MOLYBDENUM	U	mg/kg
99RC-DP01-S-1-05	REG	11/3/1999 MOLYBDENUM	U	mg/kg
99RC-DP02-S-1-05	REG	11/2/1999 MOLYBDENUM	U	mg/kg
99RC-DP05-S-1-18	REG	11/3/1999 MOLYBDENUM	U	mg/kg
99RC-DP07-S-1-05	REG	11/2/1999 MOLYBDENUM	U	mg/kg
99RC-DP07-S-1-10	REG	11/2/1999 MOLYBDENUM	U	mg/kg
99RC-DP07-S-1-16	REG	11/2/1999 MOLYBDENUM	U	mg/kg
99RC-DP07-S-1-21	REG	11/2/1999 MOLYBDENUM	U	mg/kg
99RC-MW01-S-1-05	REG	11/1/1999 MOLYBDENUM	U	mg/kg
99RC-MW04-S-1-10	REG	11/8/1999 MOLYBDENUM	U	mg/kg
99RC-MW04-S-1-20	REG	11/8/1999 MOLYBDENUM	U	mg/kg
99RC-MW04-S-3-15	DUP	11/8/1999 MOLYBDENUM	UJ	mg/kg

SAMPLE ID NUMBER	TYPE	SAMPLE DATE	ANALYTE	RESULT	Qualifier	UNIT
00RC-DP11-S-1-16	REG	1/26/2000	NICKEL	39.2		mg/kg
00RC-DP08-S-3-24	DUP	1/25/2000	NICKEL	38.7		mg/kg
99RC-DP01-S-1-10	REG	11/3/1999	NICKEL	38.1		mg/kg
99RC-MW03-S-1-20	REG	11/4/1999	NICKEL	37.6		mg/kg
99RC-DP04-S-1-05	REG	11/3/1999	NICKEL	36.4		mg/kg
99RC-DP05-S-3-05	DUP	11/3/1999	NICKEL	36.4		mg/kg
99RC-MW03-S-1-10	REG	11/4/1999	NICKEL	36.3		mg/kg
99RC-MW02-S-1-10	REG	11/9/1999	NICKEL	35.3		mg/kg
99RC-DP03-S-3-18	DUP	11/2/1999	NICKEL	35.1		mg/kg
00RC-DP11-S-1-10	REG	1/26/2000	NICKEL	34.6		mg/kg
99RC-MW01-S-1-20	REG	11/1/1999	NICKEL	34.5		mg/kg
99RC-MW03-S-1-15	REG	11/4/1999	NICKEL	34.5		mg/kg
99RC-DP05-S-1-12	REG	11/3/1999	NICKEL	33.5		mg/kg
00RC-DP10-S-1-10	REG	1/26/2000	NICKEL	33.3		mg/kg
99RC-DP05-S-1-05	REG	11/3/1999	NICKEL	33.3		mg/kg
99RC-MW01-S-1-10	REG	11/1/1999	NICKEL	32.5		mg/kg
99RC-MW01-S-1-25	REG	11/1/1999	NICKEL	32.3		mg/kg
99RC-MW02-S-1-26	REG	11/9/1999	NICKEL	32.2		mg/kg
99RC-MW05-S-1-26	REG	11/5/1999	NICKEL	32		mg/kg
99RC-DP02-S-1-18	REG	11/2/1999	NICKEL	31.3		mg/kg
99RC-MW03-S-3-15	DUP	11/4/1999	NICKEL	30.9		mg/kg
00RC-DP08-S-1-18	REG	1/25/2000	NICKEL	30.8		mg/kg
99RC-DP01-S-3-20	DUP	11/3/1999	NICKEL	30.8		mg/kg
00RC-DP11-S-1-24	REG	1/26/2000	NICKEL	30.4 J		mg/kg
00RC-DP08-S-1-24	REG	1/25/2000	NICKEL	30.2		mg/kg
99RC-MW01-S-1-05	REG	11/1/1999	NICKEL	30.1		mg/kg
00RC-DP10-S-1-5	REG	1/26/2000	NICKEL	29.9		mg/kg
99RC-DP03-S-1-18	REG	11/2/1999	NICKEL	29.5		mg/kg
00RC-DP09-S-1-19	REG	1/24/2000	NICKEL	29.3		mg/kg
99RC-DP03-S-1-12	REG	11/1/1999	NICKEL	28.5		mg/kg
99RC-DP02-S-1-12	REG	11/2/1999	NICKEL	28.1		mg/kg
99RC-MW02-S-1-05	REG	11/9/1999	NICKEL	28.1		mg/kg
99RC-DP01-S-1-15	REG	11/3/1999	NICKEL	27.9		mg/kg
00RC-MW07-S-1-19	REG	1/24/2000	NICKEL	27.8		mg/kg
00RC-DP09-S-1-25	REG	1/24/2000	NICKEL	27.7		mg/kg
00RC-MW07-S-1-25	REG	1/24/2000	NICKEL	27.6		mg/kg
99RC-DP05-S-1-25	REG	11/3/1999	NICKEL	26.7		mg/kg
99RC-DP07-S-1-21	REG	11/2/1999	NICKEL	26.1		mg/kg
99RC-DP03-S-1-05	REG	11/1/1999	NICKEL	26		mg/kg
99RC-DP02-S-1-05	REG	11/2/1999	NICKEL	25.6		mg/kg
99RC-DP04-S-1-12	DUP	11/3/1999	NICKEL	25.6		mg/kg
99RC-DP01-S-1-25	REG	11/3/1999	NICKEL	25.4		mg/kg
00RC-DP09-S-1-12	REG	1/24/2000	NICKEL	25.3		mg/kg
99RC-DP01-S-1-20	REG	11/3/1999	NICKEL	25.3		mg/kg
00RC-DP11-S-1-5	REG	1/26/2000	NICKEL	24.9		mg/kg
00RC-MW07-S-1-12	REG	1/24/2000	NICKEL	24.7		mg/kg
00RC-DP08-S-1-12	REG	1/25/2000	NICKEL	24.4		mg/kg
99RC-MW02-S-1-21	REG	11/9/1999	NICKEL	24.4		mg/kg

99RC-MW03-S-1-26	REG	11/4/1999 NICKEL	24.4	mg/kg
00RC-MW06-S-1-10	REG	1/25/2000 NICKEL	24.2	mg/kg
00RC-MW07-S-1-05	REG	1/24/2000 NICKEL	24.1	mg/kg
00RC-MW06-S-1-20	REG	1/25/2000 NICKEL	24	mg/kg
99RC-DP01-S-1-05	REG	11/3/1999 NICKEL	23.5	mg/kg
99RC-MW04-S-1-20	REG	11/8/1999 NICKEL	23.5	mg/kg
99RC-DP02-S-1-25	REG	11/2/1999 NICKEL	23.4	mg/kg
99RC-DP06-S-1-11	REG	11/4/1999 NICKEL	23.4	mg/kg
99RC-MW05-S-1-15	REG	11/5/1999 NICKEL	23.4	mg/kg
99RC-MW05-S-3-15	DUP	11/5/1999 NICKEL	23.4	mg/kg
99RC-DP04-S-1-25	DUP	11/3/1999 NICKEL	23	mg/kg
00RC-DP10-S-1-23	REG	1/26/2000 NICKEL	22.7	mg/kg
99RC-DP07-S-1-16	REG	11/2/1999 NICKEL	22.3	mg/kg
99RC-DP03-S-1-25	REG	11/2/1999 NICKEL	22.2	mg/kg
00RC-DP09-S-1-5	REG	1/24/2000 NICKEL	21.4	mg/kg
00RC-DP10-S-1-17	REG	1/26/2000 NICKEL	20.5	mg/kg
99RC-DP06-S-1-05	REG	11/4/1999 NICKEL	20.4	mg/kg
99RC-DP07-S-1-05	REG	11/2/1999 NICKEL	20	mg/kg
99RC-MW05-S-1-10	REG	11/5/1999 NICKEL	20	mg/kg
99RC-DP07-S-1-10	REG	11/2/1999 NICKEL	19.3	mg/kg
99RC-MW04-S-3-15	DUP	11/8/1999 NICKEL	19.2	mg/kg
99RC-DP04-S-1-18	DUP	11/3/1999 NICKEL	18.6	mg/kg
00RC-DP08-S-1-5	REG	1/25/2000 NICKEL	18.4	mg/kg
00RC-DP11-S-3-24	DUP	1/26/2000 NICKEL	18.3 J	mg/kg
99RC-MW05-S-1-21	REG	11/5/1999 NICKEL	18.2	mg/kg
99RC-MW04-S-1-10	REG	11/8/1999 NICKEL	17.6	mg/kg
00RC-MW06-S-1-5	REG	1/25/2000 NICKEL	17.4	mg/kg
99RC-DP05-S-1-18	REG	11/3/1999 NICKEL	17.4	mg/kg
99RC-MW04-S-1-15	REG	11/8/1999 NICKEL	17.3	mg/kg
99RC-MW04-S-1-05	REG	11/8/1999 NICKEL	16	mg/kg
99RC-DP06-S-1-20	REG	11/4/1999 NICKEL	12	mg/kg
00RC-MW06-S-1-15	REG	1/25/2000 NICKEL	10.3 J	mg/kg
00RC-MW06-S-3-15	DUP	1/25/2000 NICKEL	6.3 J	mg/kg
99RC-DP06-S-1-16	REG	11/4/1999 NICKEL	5.6	mg/kg

SAMPLE ID NUMBER	TYPE	SAMPLE DATE	ANALYTE	RESULT	Qualifier	UNIT
00RC-DP11-S-1-10	REG	1/26/2000	SELENIUM	9.7		mg/kg
00RC-DP09-S-1-12	REG	1/24/2000	SELENIUM	8.9	J	mg/kg
00RC-DP09-S-1-19	REG	1/24/2000	SELENIUM	8.5	J	mg/kg
00RC-DP11-S-1-16	REG	1/26/2000	SELENIUM	8		mg/kg
00RC-DP08-S-3-24	DUP	1/25/2000	SELENIUM	7.4	J	mg/kg
00RC-MW07-S-1-12	REG	1/24/2000	SELENIUM	7.4	J	mg/kg
00RC-DP10-S-1-5	REG	1/26/2000	SELENIUM	7.2		mg/kg
00RC-DP09-S-1-25	REG	1/24/2000	SELENIUM	5.8	UJ	mg/kg
00RC-DP08-S-1-12	REG	1/25/2000	SELENIUM	5.4		mg/kg
00RC-MW07-S-1-19	REG	1/24/2000	SELENIUM	5.1	UJ	mg/kg
00RC-MW07-S-1-25	REG	1/24/2000	SELENIUM	5.1	UJ	mg/kg
00RC-DP11-S-1-5	REG	1/26/2000	SELENIUM	4.6		mg/kg
00RC-MW06-S-1-20	REG	1/25/2000	SELENIUM	4.5		mg/kg
00RC-MW06-S-1-10	REG	1/25/2000	SELENIUM	4.4		mg/kg
00RC-DP08-S-1-5	REG	1/25/2000	SELENIUM	3.9		mg/kg
00RC-DP10-S-1-10	REG	1/26/2000	SELENIUM	3.8		mg/kg
99RC-DP06-S-1-20	REG	11/4/1999	SELENIUM	3.7		mg/kg
99RC-MW04-S-3-15	DUP	11/8/1999	SELENIUM	3.6	J	mg/kg
99RC-DP04-S-1-18	DUP	11/3/1999	SELENIUM	3.5	UJ	mg/kg
99RC-DP05-S-1-25	REG	11/3/1999	SELENIUM	3.5	UJ	mg/kg
00RC-DP09-S-1-5	REG	1/24/2000	SELENIUM	3.2	UJ	mg/kg
00RC-DP10-S-1-17	REG	1/26/2000	SELENIUM	3.1		mg/kg
99RC-DP01-S-1-05	REG	11/3/1999	SELENIUM	2.8	UJ	mg/kg
99RC-DP02-S-1-25	REG	11/2/1999	SELENIUM	2.8		mg/kg
99RC-DP04-S-1-05	REG	11/3/1999	SELENIUM	2.7	J	mg/kg
99RC-DP05-S-1-05	REG	11/3/1999	SELENIUM	2.7	UJ	mg/kg
00RC-DP08-S-1-18	REG	1/25/2000	SELENIUM	2.6		mg/kg
99RC-DP01-S-1-20	REG	11/3/1999	SELENIUM	2.6	UJ	mg/kg
99RC-MW05-S-1-10	REG	11/5/1999	SELENIUM	2.6		mg/kg
99RC-MW02-S-1-21	REG	11/9/1999	SELENIUM	2.3		mg/kg
99RC-DP01-S-1-10	REG	11/3/1999	SELENIUM	2.2	UJ	mg/kg
99RC-MW03-S-1-20	REG	11/4/1999	SELENIUM	2.2		mg/kg
99RC-DP07-S-1-10	REG	11/2/1999	SELENIUM	2.1	J	mg/kg
99RC-DP07-S-1-05	REG	11/2/1999	SELENIUM	2	J	mg/kg
99RC-MW03-S-1-10	REG	11/4/1999	SELENIUM	2		mg/kg
99RC-MW04-S-1-05	REG	11/8/1999	SELENIUM	2		mg/kg
99RC-MW02-S-1-10	REG	11/9/1999	SELENIUM	1.9		mg/kg
00RC-MW06-S-1-5	REG	1/25/2000	SELENIUM	1.8		mg/kg
99RC-DP05-S-1-18	REG	11/3/1999	SELENIUM	1.8	UJ	mg/kg
00RC-DP11-S-1-24	REG	1/26/2000	SELENIUM	1.7	J	mg/kg
99RC-MW02-S-1-26	REG	11/9/1999	SELENIUM	1.7		mg/kg
99RC-DP07-S-1-16	REG	11/2/1999	SELENIUM	1.5	J	mg/kg
00RC-MW07-S-1-05	REG	1/24/2000	SELENIUM	1.2	UJ	mg/kg
99RC-DP03-S-1-12	REG	11/1/1999	SELENIUM	1.1		mg/kg
99RC-MW03-S-3-15	DUP	11/4/1999	SELENIUM	0.85	J	mg/kg
00RC-MW06-S-1-15	REG	1/25/2000	SELENIUM	0.66		mg/kg
00RC-MW06-S-3-15	DUP	1/25/2000	SELENIUM	0.57		mg/kg
99RC-MW04-S-1-10	REG	11/8/1999	SELENIUM	0.43	J	mg/kg

99RC-DP04-S-1-25	DUP	11/3/1999 SELENIUM	0 36 UJ	mg/kg
00RC-DP10-S-1-23	REG	1/26/2000 SELENIUM	0 29 J	mg/kg
99RC-MW01-S-1-20	REG	11/1/1999 SELENIUM	0 19 J	mg/kg
00RC-DP08-S-1-24	REG	1/25/2000 SELENIUM	UJ	mg/kg
00RC-DP11-S-3-24	DUP	1/26/2000 SELENIUM	UJ	mg/kg
99RC-DP01-S-1-15	REG	11/3/1999 SELENIUM	UJ	mg/kg
99RC-DP01-S-1-25	REG	11/3/1999 SELENIUM	UJ	mg/kg
99RC-DP01-S-3-20	DUP	11/3/1999 SELENIUM	UJ	mg/kg
99RC-DP02-S-1-05	REG	11/2/1999 SELENIUM	U	mg/kg
99RC-DP02-S-1-12	REG	11/2/1999 SELENIUM	U	mg/kg
99RC-DP02-S-1-18	REG	11/2/1999 SELENIUM	U	mg/kg
99RC-DP03-S-1-05	REG	11/1/1999 SELENIUM	U	mg/kg
99RC-DP03-S-1-18	REG	11/2/1999 SELENIUM	U	mg/kg
99RC-DP03-S-1-25	REG	11/2/1999 SELENIUM	U	mg/kg
99RC-DP03-S-3-18	DUP	11/2/1999 SELENIUM	U	mg/kg
99RC-DP04-S-1-12	DUP	11/3/1999 SELENIUM	UJ	mg/kg
99RC-DP05-S-1-12	REG	11/3/1999 SELENIUM	UJ	mg/kg
99RC-DP05-S-3-05	DUP	11/3/1999 SELENIUM	UJ	mg/kg
99RC-DP06-S-1-05	REG	11/4/1999 SELENIUM	U	mg/kg
99RC-DP06-S-1-11	REG	11/4/1999 SELENIUM	U	mg/kg
99RC-DP06-S-1-16	REG	11/4/1999 SELENIUM	U	mg/kg
99RC-DP07-S-1-21	REG	11/2/1999 SELENIUM	U	mg/kg
99RC-MW01-S-1-05	REG	11/1/1999 SELENIUM	U	mg/kg
99RC-MW01-S-1-10	REG	11/1/1999 SELENIUM	U	mg/kg
99RC-MW01-S-1-25	REG	11/1/1999 SELENIUM	U	mg/kg
99RC-MW02-S-1-05	REG	11/9/1999 SELENIUM	U	mg/kg
99RC-MW03-S-1-15	REG	11/4/1999 SELENIUM	UJ	mg/kg
99RC-MW03-S-1-26	REG	11/4/1999 SELENIUM	U	mg/kg
99RC-MW04-S-1-15	REG	11/8/1999 SELENIUM	UJ	mg/kg
99RC-MW04-S-1-20	REG	11/8/1999 SELENIUM	U	mg/kg
99RC-MW05-S-1-15	REG	11/5/1999 SELENIUM	U	mg/kg
99RC-MW05-S-1-21	REG	11/5/1999 SELENIUM	U	mg/kg
99RC-MW05-S-1-26	REG	11/5/1999 SELENIUM	U	mg/kg
99RC-MW05-S-3-15	DUP	11/5/1999 SELENIUM	U	mg/kg

SAMPLE ID NUMBER	TYPE	SAMPLE DATE	ANALYTE	RESULT	Qualifier	UNIT
00RC-DP11-S-1-24	REG	1/26/2000	SILVER	1.2	UJ	mg/kg
99RC-DP03-S-1-05	REG	11/1/1999	SILVER	0.92	U	mg/kg
99RC-MW05-S-1-10	REG	11/5/1999	SILVER	0.83	U	mg/kg
99RC-DP07-S-1-21	REG	11/2/1999	SILVER	0.79	U	mg/kg
99RC-DP02-S-1-12	REG	11/2/1999	SILVER	0.76	U	mg/kg
99RC-MW01-S-1-05	REG	11/1/1999	SILVER	0.76		mg/kg
99RC-DP02-S-1-18	REG	11/2/1999	SILVER	0.65	U	mg/kg
99RC-MW05-S-3-15	DUP	11/5/1999	SILVER	0.44	UJ	mg/kg
99RC-DP03-S-3-18	DUP	11/2/1999	SILVER	0.42	UJ	mg/kg
99RC-MW03-S-1-26	REG	11/4/1999	SILVER	0.38	U	mg/kg
00RC-DP11-S-3-24	DUP	1/26/2000	SILVER	0.3	UJ	mg/kg
99RC-MW05-S-1-26	REG	11/5/1999	SILVER	0.29	U	mg/kg
99RC-DP03-S-1-12	REG	11/1/1999	SILVER	0.27	U	mg/kg
99RC-MW01-S-1-20	REG	11/1/1999	SILVER	0.15	U	mg/kg
99RC-DP05-S-1-05	REG	11/3/1999	SILVER	0.065	J	mg/kg
00RC-DP08-S-1-12	REG	1/25/2000	SILVER		U	mg/kg
00RC-DP08-S-1-18	REG	1/25/2000	SILVER		U	mg/kg
00RC-DP08-S-1-24	REG	1/25/2000	SILVER		U	mg/kg
00RC-DP08-S-1-5	REG	1/25/2000	SILVER		U	mg/kg
00RC-DP08-S-3-24	DUP	1/25/2000	SILVER		U	mg/kg
00RC-DP09-S-1-12	REG	1/24/2000	SILVER		U	mg/kg
00RC-DP09-S-1-19	REG	1/24/2000	SILVER		U	mg/kg
00RC-DP09-S-1-25	REG	1/24/2000	SILVER		U	mg/kg
00RC-DP09-S-1-5	REG	1/24/2000	SILVER		U	mg/kg
00RC-DP10-S-1-10	REG	1/26/2000	SILVER		U	mg/kg
00RC-DP10-S-1-17	REG	1/26/2000	SILVER		U	mg/kg
00RC-DP10-S-1-23	REG	1/26/2000	SILVER		U	mg/kg
00RC-DP10-S-1-5	REG	1/26/2000	SILVER		U	mg/kg
00RC-DP11-S-1-10	REG	1/26/2000	SILVER		U	mg/kg
00RC-DP11-S-1-16	REG	1/26/2000	SILVER		U	mg/kg
00RC-DP11-S-1-5	REG	1/26/2000	SILVER		U	mg/kg
00RC-MW06-S-1-10	REG	1/25/2000	SILVER		U	mg/kg
00RC-MW06-S-1-15	REG	1/25/2000	SILVER		U	mg/kg
00RC-MW06-S-1-20	REG	1/25/2000	SILVER		U	mg/kg
00RC-MW06-S-1-5	REG	1/25/2000	SILVER		U	mg/kg
00RC-MW06-S-3-15	DUP	1/25/2000	SILVER		U	mg/kg
00RC-MW07-S-1-05	REG	1/24/2000	SILVER		U	mg/kg
00RC-MW07-S-1-12	REG	1/24/2000	SILVER		U	mg/kg
00RC-MW07-S-1-19	REG	1/24/2000	SILVER		U	mg/kg
00RC-MW07-S-1-25	REG	1/24/2000	SILVER		U	mg/kg
99RC-DP01-S-1-05	REG	11/3/1999	SILVER		U	mg/kg
99RC-DP01-S-1-10	REG	11/3/1999	SILVER		U	mg/kg
99RC-DP01-S-1-15	REG	11/3/1999	SILVER		U	mg/kg
99RC-DP01-S-1-20	REG	11/3/1999	SILVER		U	mg/kg
99RC-DP01-S-1-25	REG	11/3/1999	SILVER		U	mg/kg
99RC-DP01-S-3-20	DUP	11/3/1999	SILVER		U	mg/kg
99RC-DP02-S-1-05	REG	11/2/1999	SILVER		U	mg/kg
99RC-DP02-S-1-25	REG	11/2/1999	SILVER		U	mg/kg

99RC-DP03-S-1-18	REG	11/2/1999 SILVER	UJ	mg/kg
99RC-DP03-S-1-25	REG	11/2/1999 SILVER	U	mg/kg
99RC-DP04-S-1-05	REG	11/3/1999 SILVER	U	mg/kg
99RC-DP04-S-1-12	DUP	11/3/1999 SILVER	U	mg/kg
99RC-DP04-S-1-18	DUP	11/3/1999 SILVER	U	mg/kg
99RC-DP04-S-1-25	DUP	11/3/1999 SILVER	U	mg/kg
99RC-DP05-S-1-12	REG	11/3/1999 SILVER	U	mg/kg
99RC-DP05-S-1-18	REG	11/3/1999 SILVER	U	mg/kg
99RC-DP05-S-1-25	REG	11/3/1999 SILVER	U	mg/kg
99RC-DP05-S-3-05	DUP	11/3/1999 SILVER	UJ	mg/kg
99RC-DP06-S-1-05	REG	11/4/1999 SILVER	U	mg/kg
99RC-DP06-S-1-11	REG	11/4/1999 SILVER	U	mg/kg
99RC-DP06-S-1-16	REG	11/4/1999 SILVER	U	mg/kg
99RC-DP06-S-1-20	REG	11/4/1999 SILVER	U	mg/kg
99RC-DP07-S-1-05	REG	11/2/1999 SILVER	U	mg/kg
99RC-DP07-S-1-10	REG	11/2/1999 SILVER	U	mg/kg
99RC-DP07-S-1-16	REG	11/2/1999 SILVER	U	mg/kg
99RC-MW01-S-1-10	REG	11/1/1999 SILVER	U	mg/kg
99RC-MW01-S-1-25	REG	11/1/1999 SILVER	U	mg/kg
99RC-MW02-S-1-05	REG	11/9/1999 SILVER	U	mg/kg
99RC-MW02-S-1-10	REG	11/9/1999 SILVER	U	mg/kg
99RC-MW02-S-1-21	REG	11/9/1999 SILVER	U	mg/kg
99RC-MW02-S-1-26	REG	11/9/1999 SILVER	U	mg/kg
99RC-MW03-S-1-10	REG	11/4/1999 SILVER	U	mg/kg
99RC-MW03-S-1-15	REG	11/4/1999 SILVER	U	mg/kg
99RC-MW03-S-1-20	REG	11/4/1999 SILVER	U	mg/kg
99RC-MW03-S-3-15	DUP	11/4/1999 SILVER	U	mg/kg
99RC-MW04-S-1-05	REG	11/8/1999 SILVER	U	mg/kg
99RC-MW04-S-1-10	REG	11/8/1999 SILVER	U	mg/kg
99RC-MW04-S-1-15	REG	11/8/1999 SILVER	U	mg/kg
99RC-MW04-S-1-20	REG	11/8/1999 SILVER	U	mg/kg
99RC-MW04-S-3-15	DUP	11/8/1999 SILVER	U	mg/kg
99RC-MW05-S-1-15	REG	11/5/1999 SILVER	UJ	mg/kg
99RC-MW05-S-1-21	REG	11/5/1999 SILVER	U	mg/kg

SAMPLE ID NUMBER	TYPE	SAMPLE DATE	ANALYTE	RESULT	Qualifier	UNIT
99RC-DP05-S-1-25	REG	11/3/1999	THALLIUM	1.4	U	mg/kg
99RC-DP06-S-1-05	REG	11/4/1999	THALLIUM	1.4		mg/kg
99RC-DP05-S-1-05	REG	11/3/1999	THALLIUM	0.97	UJ	mg/kg
99RC-MW04-S-1-10	REG	11/8/1999	THALLIUM	0.51	U	mg/kg
00RC-DP09-S-1-5	REG	1/24/2000	THALLIUM	0.47	J	mg/kg
99RC-MW05-S-1-21	REG	11/5/1999	THALLIUM	0.32	U	mg/kg
00RC-DP08-S-1-12	REG	1/25/2000	THALLIUM		U	mg/kg
00RC-DP08-S-1-18	REG	1/25/2000	THALLIUM		U	mg/kg
00RC-DP08-S-1-24	REG	1/25/2000	THALLIUM		U	mg/kg
00RC-DP08-S-1-5	REG	1/25/2000	THALLIUM		U	mg/kg
00RC-DP08-S-3-24	DUP	1/25/2000	THALLIUM		U	mg/kg
00RC-DP09-S-1-12	REG	1/24/2000	THALLIUM		U	mg/kg
00RC-DP09-S-1-19	REG	1/24/2000	THALLIUM		U	mg/kg
00RC-DP09-S-1-25	REG	1/24/2000	THALLIUM		U	mg/kg
00RC-DP10-S-1-10	REG	1/26/2000	THALLIUM		U	mg/kg
00RC-DP10-S-1-17	REG	1/26/2000	THALLIUM		U	mg/kg
00RC-DP10-S-1-23	REG	1/26/2000	THALLIUM		U	mg/kg
00RC-DP10-S-1-5	REG	1/26/2000	THALLIUM		U	mg/kg
00RC-DP11-S-1-10	REG	1/26/2000	THALLIUM		U	mg/kg
00RC-DP11-S-1-16	REG	1/26/2000	THALLIUM		U	mg/kg
00RC-DP11-S-1-24	REG	1/26/2000	THALLIUM		U	mg/kg
00RC-DP11-S-1-5	REG	1/26/2000	THALLIUM		U	mg/kg
00RC-DP11-S-3-24	DUP	1/26/2000	THALLIUM		U	mg/kg
00RC-MW06-S-1-10	REG	1/25/2000	THALLIUM		U	mg/kg
00RC-MW06-S-1-15	REG	1/25/2000	THALLIUM		U	mg/kg
00RC-MW06-S-1-20	REG	1/25/2000	THALLIUM		U	mg/kg
00RC-MW06-S-1-5	REG	1/25/2000	THALLIUM		U	mg/kg
00RC-MW06-S-3-15	DUP	1/25/2000	THALLIUM		U	mg/kg
00RC-MW07-S-1-05	REG	1/24/2000	THALLIUM		U	mg/kg
00RC-MW07-S-1-12	REG	1/24/2000	THALLIUM		U	mg/kg
00RC-MW07-S-1-19	REG	1/24/2000	THALLIUM		U	mg/kg
00RC-MW07-S-1-25	REG	1/24/2000	THALLIUM		U	mg/kg
99RC-DP01-S-1-05	REG	11/3/1999	THALLIUM		U	mg/kg
99RC-DP01-S-1-10	REG	11/3/1999	THALLIUM		U	mg/kg
99RC-DP01-S-1-15	REG	11/3/1999	THALLIUM		U	mg/kg
99RC-DP01-S-1-20	REG	11/3/1999	THALLIUM		U	mg/kg
99RC-DP01-S-1-25	REG	11/3/1999	THALLIUM		U	mg/kg
99RC-DP01-S-3-20	DUP	11/3/1999	THALLIUM		U	mg/kg
99RC-DP02-S-1-05	REG	11/2/1999	THALLIUM		U	mg/kg
99RC-DP02-S-1-12	REG	11/2/1999	THALLIUM		U	mg/kg
99RC-DP02-S-1-18	REG	11/2/1999	THALLIUM		U	mg/kg
99RC-DP02-S-1-25	REG	11/2/1999	THALLIUM		U	mg/kg
99RC-DP03-S-1-05	REG	11/1/1999	THALLIUM		U	mg/kg
99RC-DP03-S-1-12	REG	11/1/1999	THALLIUM		U	mg/kg
99RC-DP03-S-1-18	REG	11/2/1999	THALLIUM		U	mg/kg
99RC-DP03-S-1-25	REG	11/2/1999	THALLIUM		U	mg/kg
99RC-DP03-S-3-18	DUP	11/2/1999	THALLIUM		U	mg/kg
99RC-DP04-S-1-05	REG	11/3/1999	THALLIUM		U	mg/kg

99RC-DP04-S-1-12	DUP	11/3/1999 THALLIUM	U	mg/kg
99RC-DP04-S-1-18	DUP	11/3/1999 THALLIUM	U	mg/kg
99RC-DP04-S-1-25	DUP	11/3/1999 THALLIUM	U	mg/kg
99RC-DP05-S-1-12	REG	11/3/1999 THALLIUM	U	mg/kg
99RC-DP05-S-1-18	REG	11/3/1999 THALLIUM	U	mg/kg
99RC-DP05-S-3-05	DUP	11/3/1999 THALLIUM	UJ	mg/kg
99RC-DP06-S-1-11	REG	11/4/1999 THALLIUM	U	mg/kg
99RC-DP06-S-1-16	REG	11/4/1999 THALLIUM	U	mg/kg
99RC-DP06-S-1-20	REG	11/4/1999 THALLIUM	U	mg/kg
99RC-DP07-S-1-05	REG	11/2/1999 THALLIUM	U	mg/kg
99RC-DP07-S-1-10	REG	11/2/1999 THALLIUM	U	mg/kg
99RC-DP07-S-1-16	REG	11/2/1999 THALLIUM	U	mg/kg
99RC-DP07-S-1-21	REG	11/2/1999 THALLIUM	U	mg/kg
99RC-MW01-S-1-05	REG	11/1/1999 THALLIUM	U	mg/kg
99RC-MW01-S-1-10	REG	11/1/1999 THALLIUM	U	mg/kg
99RC-MW01-S-1-20	REG	11/1/1999 THALLIUM	U	mg/kg
99RC-MW01-S-1-25	REG	11/1/1999 THALLIUM	U	mg/kg
99RC-MW02-S-1-05	REG	11/9/1999 THALLIUM	U	mg/kg
99RC-MW02-S-1-10	REG	11/9/1999 THALLIUM	U	mg/kg
99RC-MW02-S-1-21	REG	11/9/1999 THALLIUM	U	mg/kg
99RC-MW02-S-1-26	REG	11/9/1999 THALLIUM	U	mg/kg
99RC-MW03-S-1-10	REG	11/4/1999 THALLIUM	U	mg/kg
99RC-MW03-S-1-15	REG	11/4/1999 THALLIUM	U	mg/kg
99RC-MW03-S-1-20	REG	11/4/1999 THALLIUM	U	mg/kg
99RC-MW03-S-1-26	REG	11/4/1999 THALLIUM	U	mg/kg
99RC-MW03-S-3-15	DUP	11/4/1999 THALLIUM	U	mg/kg
99RC-MW04-S-1-05	REG	11/8/1999 THALLIUM	U	mg/kg
99RC-MW04-S-1-15	REG	11/8/1999 THALLIUM	U	mg/kg
99RC-MW04-S-1-20	REG	11/8/1999 THALLIUM	U	mg/kg
99RC-MW04-S-3-15	DUP	11/8/1999 THALLIUM	U	mg/kg
99RC-MW05-S-1-10	REG	11/5/1999 THALLIUM	U	mg/kg
99RC-MW05-S-1-15	REG	11/5/1999 THALLIUM	U	mg/kg
99RC-MW05-S-1-26	REG	11/5/1999 THALLIUM	U	mg/kg
99RC-MW05-S-3-15	DUP	11/5/1999 THALLIUM	U	mg/kg

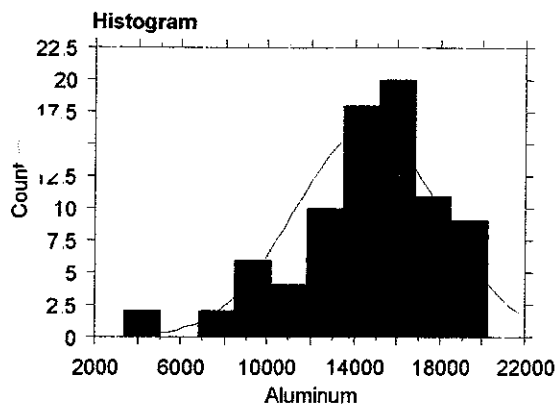
SAMPLE ID NUMBER	TYPE	SAMPLE DATE	ANALYTE	RESULT	Qualifier	UNIT
99RC-DP03-S-3-18	DUP	11/2/1999	VANADIUM	82	J	mg/kg
99RC-DP02-S-1-18	REG	11/2/1999	VANADIUM	79.3		mg/kg
99RC-DP05-S-1-05	REG	11/3/1999	VANADIUM	73.7		mg/kg
99RC-DP01-S-1-10	REG	11/3/1999	VANADIUM	73.5		mg/kg
00RC-MW07-S-1-25	REG	1/24/2000	VANADIUM	70.8		mg/kg
99RC-DP02-S-1-12	REG	11/2/1999	VANADIUM	69.5		mg/kg
99RC-DP04-S-1-05	REG	11/3/1999	VANADIUM	69.3		mg/kg
99RC-DP01-S-3-20	DUP	11/3/1999	VANADIUM	68.5		mg/kg
99RC-DP04-S-1-12	DUP	11/3/1999	VANADIUM	68.3		mg/kg
00RC-DP11-S-1-16	REG	1/26/2000	VANADIUM	67.8		mg/kg
99RC-MW02-S-1-10	REG	11/9/1999	VANADIUM	67.5		mg/kg
00RC-MW07-S-1-05	REG	1/24/2000	VANADIUM	66		mg/kg
99RC-MW01-S-1-10	REG	11/1/1999	VANADIUM	65.5		mg/kg
00RC-DP09-S-1-19	REG	1/24/2000	VANADIUM	64.9		mg/kg
00RC-DP09-S-1-12	REG	1/24/2000	VANADIUM	63.4		mg/kg
00RC-DP09-S-1-25	REG	1/24/2000	VANADIUM	63		mg/kg
99RC-DP03-S-1-12	REG	11/1/1999	VANADIUM	62.9		mg/kg
99RC-DP05-S-3-05	DUP	11/3/1999	VANADIUM	62.9		mg/kg
99RC-DP05-S-1-12	REG	11/3/1999	VANADIUM	62.1		mg/kg
00RC-DP11-S-1-10	REG	1/26/2000	VANADIUM	61.8		mg/kg
99RC-DP02-S-1-05	REG	11/2/1999	VANADIUM	61.5		mg/kg
00RC-DP10-S-1-10	REG	1/26/2000	VANADIUM	61.3		mg/kg
99RC-MW02-S-1-26	REG	11/9/1999	VANADIUM	60		mg/kg
99RC-DP01-S-1-20	REG	11/3/1999	VANADIUM	59.9		mg/kg
99RC-MW01-S-1-20	REG	11/1/1999	VANADIUM	59.2		mg/kg
99RC-MW02-S-1-05	REG	11/9/1999	VANADIUM	58.5		mg/kg
00RC-DP08-S-3-24	DUP	1/25/2000	VANADIUM	58.4		mg/kg
00RC-DP08-S-1-18	REG	1/25/2000	VANADIUM	57.4		mg/kg
99RC-DP07-S-1-21	REG	11/2/1999	VANADIUM	57.3		mg/kg
99RC-MW01-S-1-25	REG	11/1/1999	VANADIUM	57.1		mg/kg
99RC-DP01-S-1-15	REG	11/3/1999	VANADIUM	56.8		mg/kg
99RC-MW02-S-1-21	REG	11/9/1999	VANADIUM	56.8		mg/kg
99RC-MW03-S-1-15	REG	11/4/1999	VANADIUM	56.5	J	mg/kg
99RC-DP04-S-1-18	DUP	11/3/1999	VANADIUM	56.3		mg/kg
99RC-MW05-S-1-10	REG	11/5/1999	VANADIUM	55.9		mg/kg
00RC-DP08-S-1-24	REG	1/25/2000	VANADIUM	55.7		mg/kg
00RC-DP11-S-1-5	REG	1/26/2000	VANADIUM	55.6		mg/kg
00RC-DP09-S-1-5	REG	1/24/2000	VANADIUM	53.8		mg/kg
99RC-DP03-S-1-25	REG	11/2/1999	VANADIUM	53.8		mg/kg
99RC-MW03-S-1-20	REG	11/4/1999	VANADIUM	53.6		mg/kg
99RC-MW05-S-1-26	REG	11/5/1999	VANADIUM	53.5		mg/kg
00RC-MW07-S-1-12	REG	1/24/2000	VANADIUM	53.2		mg/kg
99RC-MW01-S-1-05	REG	11/1/1999	VANADIUM	53.2		mg/kg
99RC-DP01-S-1-05	REG	11/3/1999	VANADIUM	53.1		mg/kg
99RC-DP04-S-1-25	DUP	11/3/1999	VANADIUM	53		mg/kg
99RC-DP05-S-1-25	REG	11/3/1999	VANADIUM	52.9		mg/kg
99RC-DP03-S-1-18	REG	11/2/1999	VANADIUM	51.9	J	mg/kg
00RC-DP10-S-1-5	REG	1/26/2000	VANADIUM	51.7		mg/kg

00RC-DP10-S-1-23	REG	1/26/2000 VANADIUM	50.7	mg/kg
99RC-DP02-S-1-25	REG	11/2/1999 VANADIUM	50.1	mg/kg
00RC-DP08-S-1-12	REG	1/25/2000 VANADIUM	50	mg/kg
00RC-MW07-S-1-19	REG	1/24/2000 VANADIUM	49.1	mg/kg
00RC-DP11-S-1-24	REG	1/26/2000 VANADIUM	49 J	mg/kg
99RC-DP05-S-1-18	REG	11/3/1999 VANADIUM	48.7	mg/kg
99RC-DP03-S-1-05	REG	11/1/1999 VANADIUM	47.9	mg/kg
99RC-DP07-S-1-05	REG	11/2/1999 VANADIUM	47.9	mg/kg
99RC-DP07-S-1-16	REG	11/2/1999 VANADIUM	46.3	mg/kg
99RC-MW04-S-1-20	REG	11/8/1999 VANADIUM	46	mg/kg
00RC-DP08-S-1-5	REG	1/25/2000 VANADIUM	45.8	mg/kg
99RC-MW03-S-1-10	REG	11/4/1999 VANADIUM	45.4	mg/kg
99RC-DP06-S-1-11	REG	11/4/1999 VANADIUM	44.8	mg/kg
99RC-MW05-S-1-21	REG	11/5/1999 VANADIUM	44.1	mg/kg
99RC-DP06-S-1-05	REG	11/4/1999 VANADIUM	42.2	mg/kg
00RC-MW06-S-1-20	REG	1/25/2000 VANADIUM	41.5	mg/kg
99RC-MW05-S-3-15	DUP	11/5/1999 VANADIUM	41.5	mg/kg
00RC-MW06-S-1-10	REG	1/25/2000 VANADIUM	41.2	mg/kg
99RC-MW05-S-1-15	REG	11/5/1999 VANADIUM	40.8	mg/kg
99RC-DP01-S-1-25	REG	11/3/1999 VANADIUM	40.6	mg/kg
00RC-DP10-S-1-17	REG	1/26/2000 VANADIUM	39.5	mg/kg
99RC-MW03-S-3-15	DUP	11/4/1999 VANADIUM	39.3 J	mg/kg
99RC-DP07-S-1-10	REG	11/2/1999 VANADIUM	39.1	mg/kg
00RC-MW06-S-1-5	REG	1/25/2000 VANADIUM	38.3	mg/kg
99RC-MW04-S-3-15	DUP	11/8/1999 VANADIUM	37.5	mg/kg
00RC-DP11-S-3-24	DUP	1/26/2000 VANADIUM	34.7 J	mg/kg
99RC-MW04-S-1-05	REG	11/8/1999 VANADIUM	34.3	mg/kg
99RC-MW04-S-1-10	REG	11/8/1999 VANADIUM	33.7	mg/kg
99RC-MW04-S-1-15	REG	11/8/1999 VANADIUM	33.7	mg/kg
99RC-MW03-S-1-26	REG	11/4/1999 VANADIUM	33.5	mg/kg
99RC-DP06-S-1-20	REG	11/4/1999 VANADIUM	28.1	mg/kg
00RC-MW06-S-1-15	REG	1/25/2000 VANADIUM	17.5	mg/kg
00RC-MW06-S-3-15	DUP	1/25/2000 VANADIUM	12.8	mg/kg
99RC-DP06-S-1-16	REG	11/4/1999 VANADIUM	7.8	mg/kg

SAMPLE ID NUMBER	TYPE	SAMPLE DATE	ANALYTE	RESULT	Qualifier	UNIT
99RC-DP04-S-1-05	REG	11/3/1999	ZINC	102	J	mg/kg
99RC-DP01-S-1-10	REG	11/3/1999	ZINC	85.6	J	mg/kg
99RC-MW03-S-1-10	REG	11/4/1999	ZINC	84		mg/kg
99RC-DP05-S-3-05	DUP	11/3/1999	ZINC	81.2	J	mg/kg
00RC-DP11-S-1-16	REG	1/26/2000	ZINC	80.2		mg/kg
99RC-MW03-S-1-15	REG	11/4/1999	ZINC	79.9		mg/kg
00RC-MW06-S-1-5	REG	1/25/2000	ZINC	76.2		mg/kg
99RC-DP05-S-1-05	REG	11/3/1999	ZINC	74.9	J	mg/kg
99RC-DP02-S-1-18	REG	11/2/1999	ZINC	74.8		mg/kg
99RC-DP03-S-3-18	DUP	11/2/1999	ZINC	74.5		mg/kg
99RC-DP02-S-1-12	REG	11/2/1999	ZINC	73		mg/kg
99RC-MW02-S-1-10	REG	11/9/1999	ZINC	72.5		mg/kg
99RC-DP01-S-3-20	DUP	11/3/1999	ZINC	72.2	J	mg/kg
99RC-DP01-S-1-15	REG	11/3/1999	ZINC	71.2	J	mg/kg
00RC-DP08-S-1-18	REG	1/25/2000	ZINC	71.1		mg/kg
99RC-MW03-S-1-20	REG	11/4/1999	ZINC	71		mg/kg
99RC-DP05-S-1-12	REG	11/3/1999	ZINC	69.6	J	mg/kg
00RC-DP09-S-1-25	REG	1/24/2000	ZINC	68.7		mg/kg
00RC-DP08-S-3-24	DUP	1/25/2000	ZINC	68		mg/kg
99RC-DP06-S-1-05	REG	11/4/1999	ZINC	68		mg/kg
99RC-MW03-S-3-15	DUP	11/4/1999	ZINC	67.8		mg/kg
00RC-MW07-S-1-05	REG	1/24/2000	ZINC	66.8		mg/kg
00RC-DP10-S-1-10	REG	1/26/2000	ZINC	66.7		mg/kg
99RC-MW01-S-1-10	REG	11/1/1999	ZINC	66.5		mg/kg
99RC-MW01-S-1-25	REG	11/1/1999	ZINC	66.4		mg/kg
00RC-DP09-S-1-19	REG	1/24/2000	ZINC	66.2		mg/kg
99RC-MW02-S-1-21	REG	11/9/1999	ZINC	65.9		mg/kg
99RC-MW02-S-1-26	REG	11/9/1999	ZINC	65.8		mg/kg
99RC-DP03-S-1-18	REG	11/2/1999	ZINC	65.5		mg/kg
00RC-MW07-S-1-19	REG	1/24/2000	ZINC	64.8		mg/kg
99RC-DP04-S-1-25	DUP	11/3/1999	ZINC	64.7	J	mg/kg
99RC-MW05-S-1-10	REG	11/5/1999	ZINC	64.2		mg/kg
99RC-MW01-S-1-20	REG	11/1/1999	ZINC	64		mg/kg
00RC-DP11-S-1-10	REG	1/26/2000	ZINC	63.8		mg/kg
00RC-DP11-S-1-24	REG	1/26/2000	ZINC	63.8	J	mg/kg
00RC-DP08-S-1-24	REG	1/25/2000	ZINC	62.9		mg/kg
99RC-DP03-S-1-12	REG	11/1/1999	ZINC	62.7		mg/kg
00RC-MW07-S-1-12	REG	1/24/2000	ZINC	61.9		mg/kg
00RC-DP09-S-1-12	REG	1/24/2000	ZINC	61.8		mg/kg
99RC-DP02-S-1-05	REG	11/2/1999	ZINC	61.5		mg/kg
99RC-MW01-S-1-05	REG	11/1/1999	ZINC	60.5		mg/kg
00RC-DP09-S-1-5	REG	1/24/2000	ZINC	60.2		mg/kg
99RC-DP04-S-1-12	DUP	11/3/1999	ZINC	60	J	mg/kg
99RC-DP07-S-1-16	REG	11/2/1999	ZINC	59.6		mg/kg
00RC-MW07-S-1-25	REG	1/24/2000	ZINC	59.2		mg/kg
99RC-DP01-S-1-20	REG	11/3/1999	ZINC	59.1	J	mg/kg
99RC-DP03-S-1-25	REG	11/2/1999	ZINC	59.1		mg/kg
99RC-DP07-S-1-21	REG	11/2/1999	ZINC	58.9		mg/kg

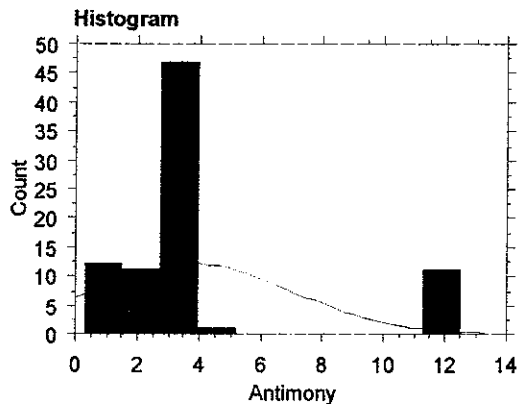
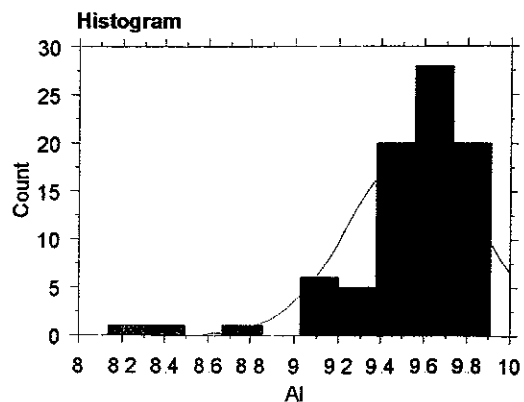
99RC-MW02-S-1-05	REG	11/9/1999 ZINC	58.7	mg/kg
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00RC-DP11-S-1-5	REG	1/26/2000 ZINC	58.4	mg/kg
00RC-DP10-S-1-5	REG	1/26/2000 ZINC	58.1	mg/kg
99RC-DP05-S-1-18	REG	11/3/1999 ZINC	57.3 J	mg/kg
00RC-DP08-S-1-12	REG	1/25/2000 ZINC	56.7	mg/kg
99RC-MW05-S-1-26	REG	11/5/1999 ZINC	56.5	mg/kg
99RC-DP01-S-1-05	REG	11/3/1999 ZINC	56.2 J	mg/kg
99RC-DP05-S-1-25	REG	11/3/1999 ZINC	55.8 J	mg/kg
99RC-DP07-S-1-05	REG	11/2/1999 ZINC	55.5	mg/kg
99RC-DP02-S-1-25	REG	11/2/1999 ZINC	55.3	mg/kg
99RC-DP07-S-1-10	REG	11/2/1999 ZINC	55.1	mg/kg
99RC-DP03-S-1-05	REG	11/1/1999 ZINC	53.8	mg/kg
99RC-DP01-S-1-25	REG	11/3/1999 ZINC	53.3 J	mg/kg
99RC-DP06-S-1-11	REG	11/4/1999 ZINC	52.7	mg/kg
99RC-MW05-S-3-15	DUP	11/5/1999 ZINC	52.4	mg/kg
99RC-MW04-S-1-20	REG	11/8/1999 ZINC	51.1	mg/kg
99RC-MW04-S-3-15	DUP	11/8/1999 ZINC	51	mg/kg
99RC-MW05-S-1-15	REG	11/5/1999 ZINC	51	mg/kg
99RC-DP04-S-1-18	DUP	11/3/1999 ZINC	49.3 J	mg/kg
99RC-MW03-S-1-26	REG	11/4/1999 ZINC	49.1	mg/kg
99RC-MW04-S-1-10	REG	11/8/1999 ZINC	48.2	mg/kg
00RC-MW06-S-1-10	REG	1/25/2000 ZINC	47.7	mg/kg
00RC-DP10-S-1-17	REG	1/26/2000 ZINC	46.4	mg/kg
00RC-MW06-S-1-20	REG	1/25/2000 ZINC	45.8	mg/kg
99RC-MW04-S-1-05	REG	11/8/1999 ZINC	44.9	mg/kg
99RC-MW05-S-1-21	REG	11/5/1999 ZINC	44.1	mg/kg
00RC-DP08-S-1-5	REG	1/25/2000 ZINC	43.4	mg/kg
99RC-MW04-S-1-15	REG	11/8/1999 ZINC	40.7	mg/kg
00RC-DP11-S-3-24	DUP	1/26/2000 ZINC	40.3 J	mg/kg
99RC-DP06-S-1-20	REG	11/4/1999 ZINC	40.2	mg/kg
00RC-MW06-S-1-15	REG	1/25/2000 ZINC	23.4 J	mg/kg
00RC-MW06-S-3-15	DUP	1/25/2000 ZINC	14.6 J	mg/kg
99RC-DP06-S-1-16	REG	11/4/1999 ZINC	13.2	mg/kg

Soil Histograms and Summary Statistics, Natural Log Histograms



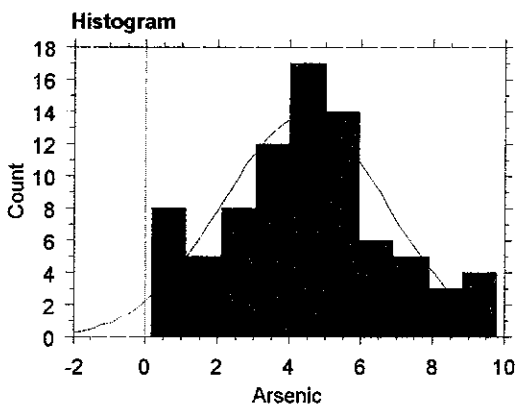
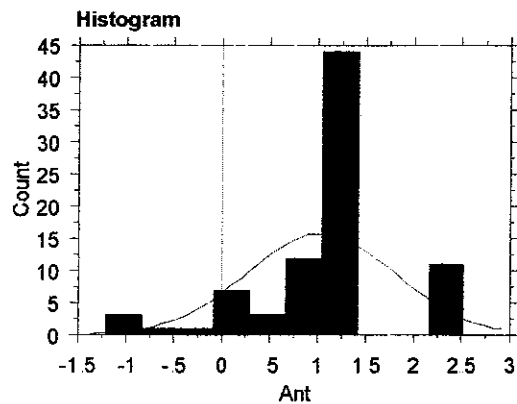
Descriptive Statistics

	Aluminum
Mean	14610.976
Std. Dev.	3382.613
Std. Error	373.547
Count	82
Minimum	3420.000
Maximum	20200.000
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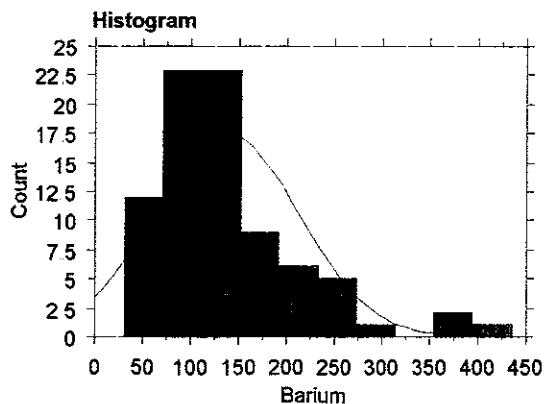
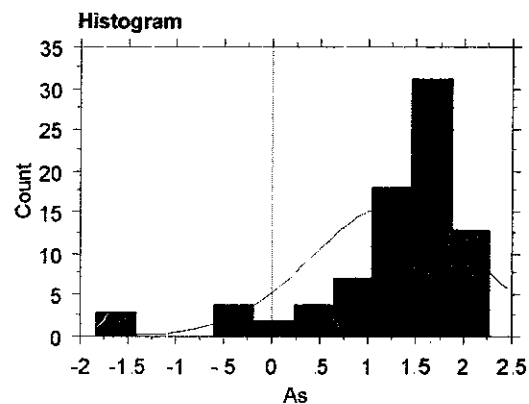
Descriptive Statistics

	Antimony
Mean	3.754
Std. Dev.	3.297
Std. Error	.364
Count	82
Minimum	.300
Maximum	12.500
# Missing	0



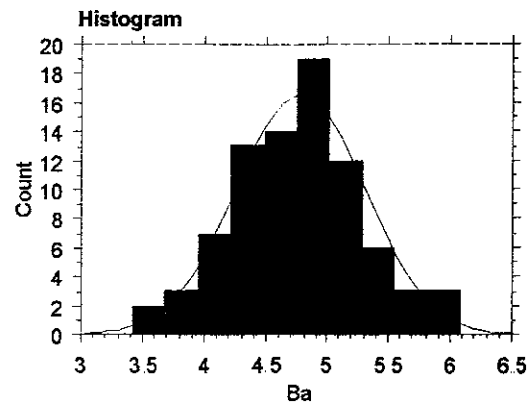
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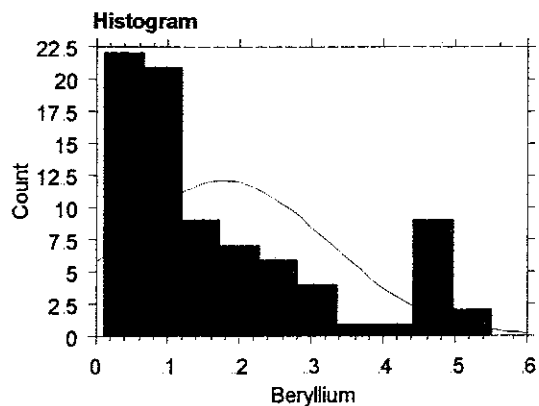
	Arsenic
Mean	4.407
Std. Dev.	2.302
Std. Error	.254
Count	82
Minimum	.160
Maximum	9.800
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Descriptive Statistics

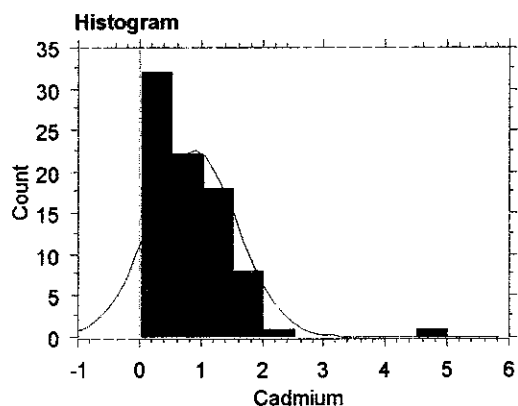
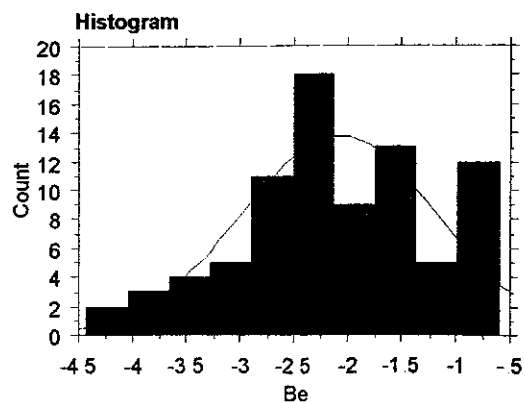
	Barium
Mean	136.559
Std. Dev.	75.794
Std. Error	8.370
Count	82
Minimum	30.500
Maximum	435.000
# Missing	0





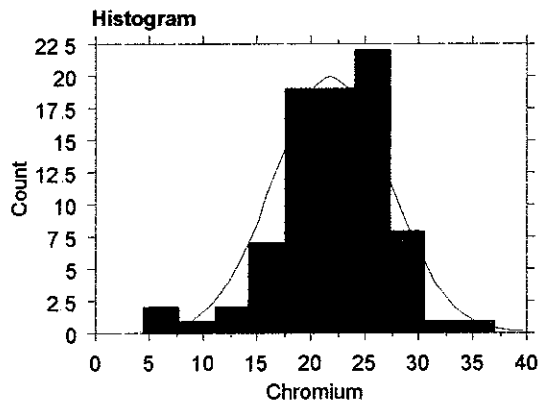
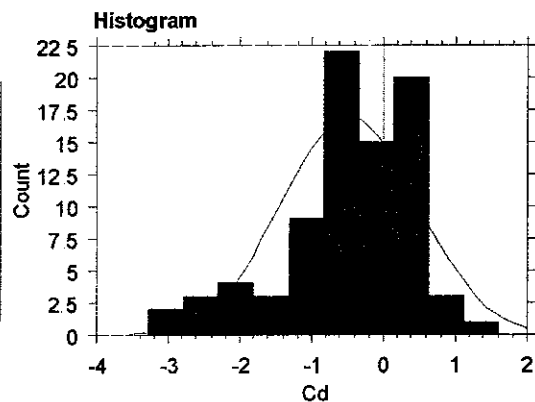
Descriptive Statistics

Beryllium	
Mean	.178
Std Dev.	.146
Std Error	.016
Count	82
Minimum	.012
Maximum	.550
# Missing	0



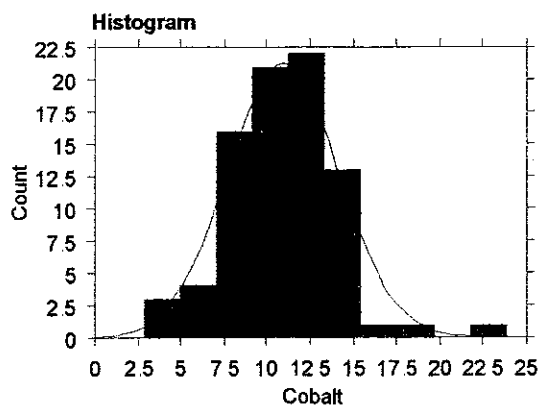
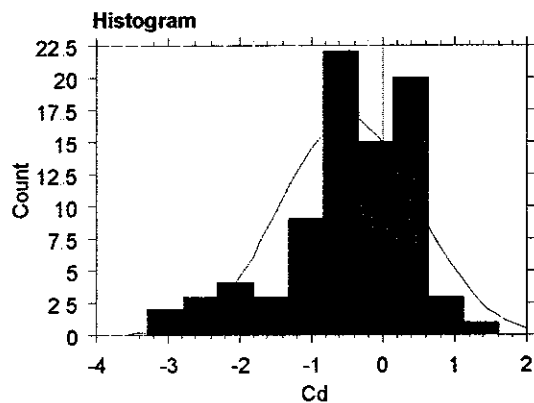
Descriptive Statistics

Cadmium	
Mean	.878
Std Dev	.720
Std Error	.080
Count	82
Minimum	.038
Maximum	5.000
# Missing	0



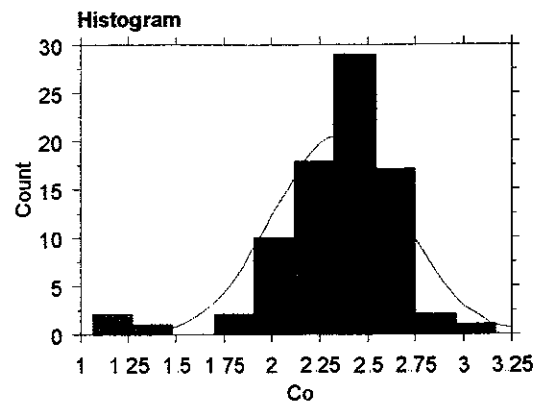
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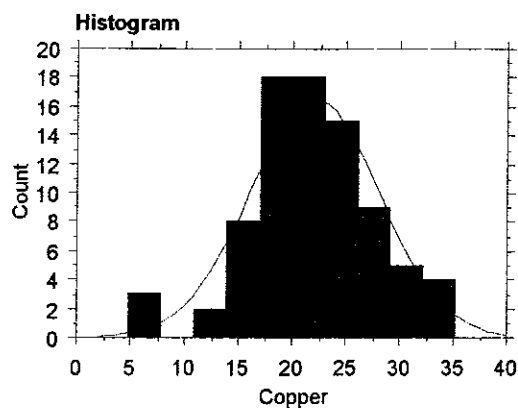
Chromium	
Mean	21.939
Std Dev.	5.346
Std Error	.590
Count	82
Minimum	4.500
Maximum	37.100
# Missing	0



Descriptive Statistics

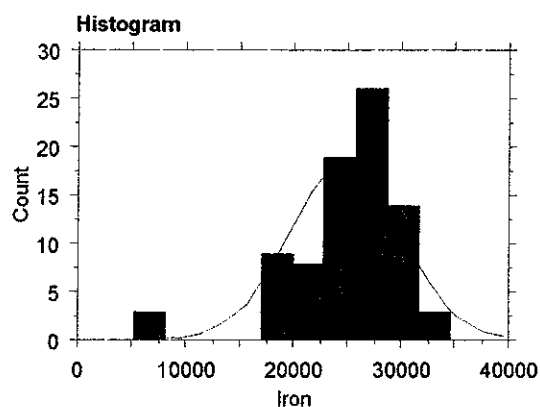
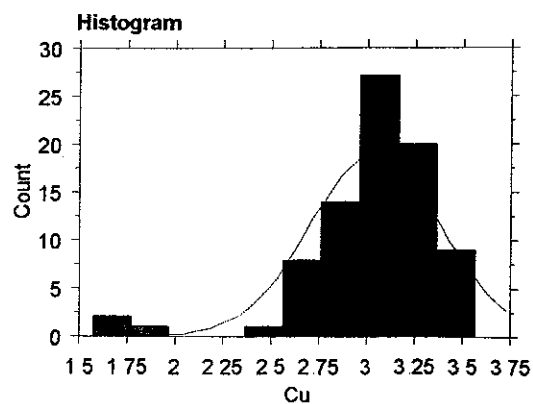
Cobalt	
Mean	10.920
Std. Dev.	3.212
Std Error	.355
Count	82
Minimum	2.900
Maximum	23.800
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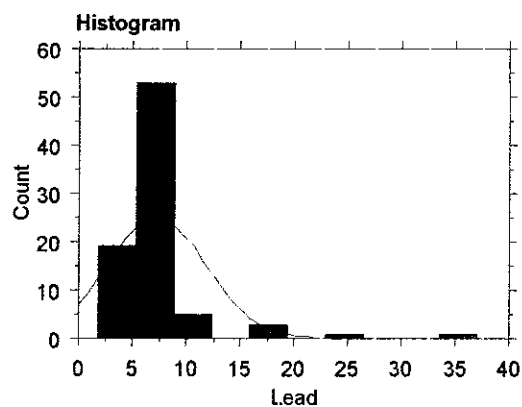
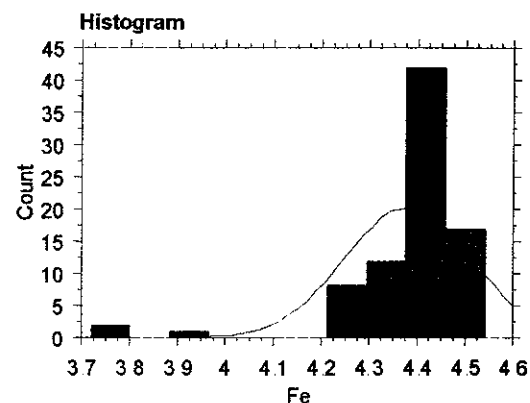
Descriptive Statistics

Copper	
Mean	22.049
Std. Dev.	6.021
Std. Error	.665
Count	82
Minimum	4.800
Maximum	35.200
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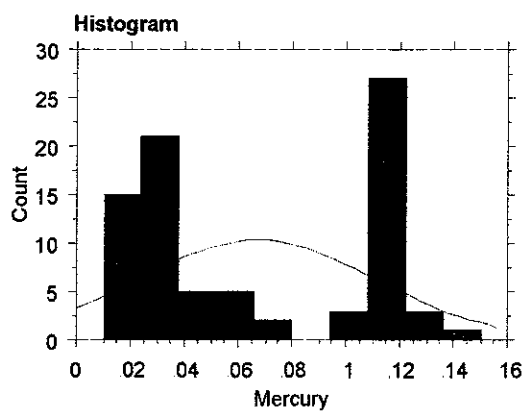
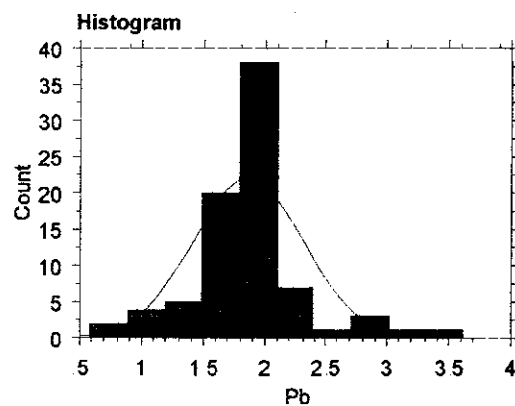
Descriptive Statistics

Iron	
Mean	24873.293
Std. Dev.	5213.428
Std. Error	575.727
Count	82
Minimum	5250.000
Maximum	34600.000
# Missing	0



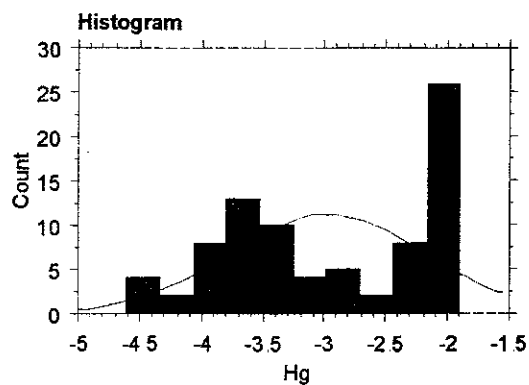
Descriptive Statistics

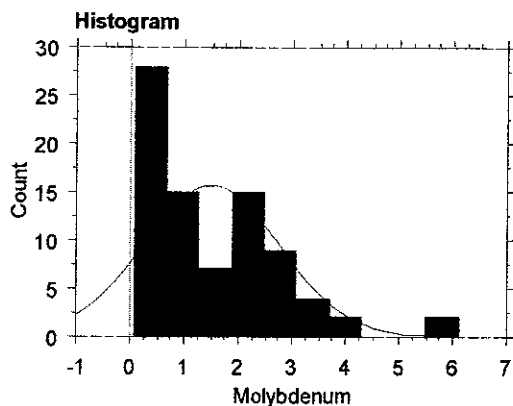
Lead	
Mean	7.263
Std. Dev.	4.641
Std. Error	.512
Count	82
Minimum	1.800
Maximum	37.000
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Descriptive Statistics

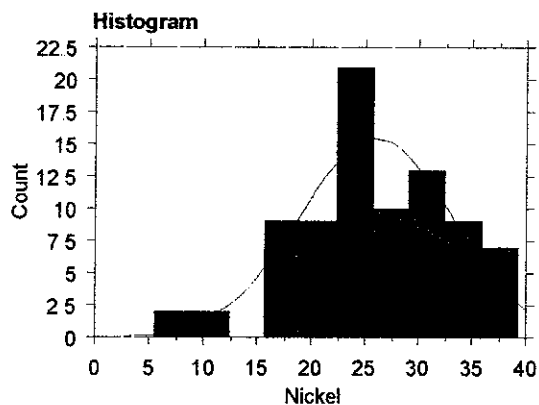
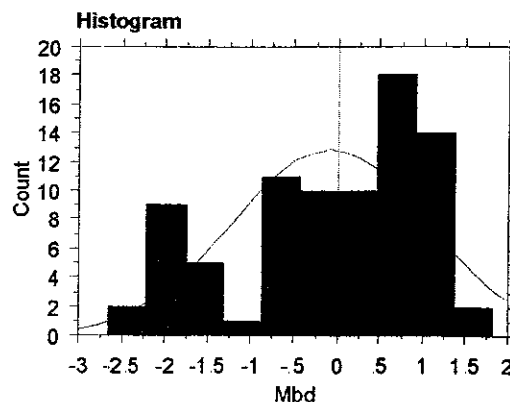
Mercury	
Mean	.067
Std. Dev.	.044
Std. Error	.005
Count	82
Minimum	.010
Maximum	.150
# Missing	0





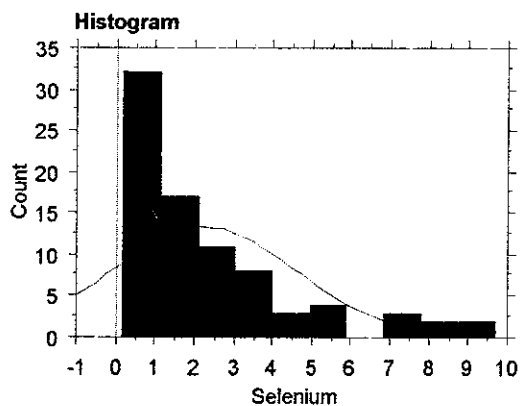
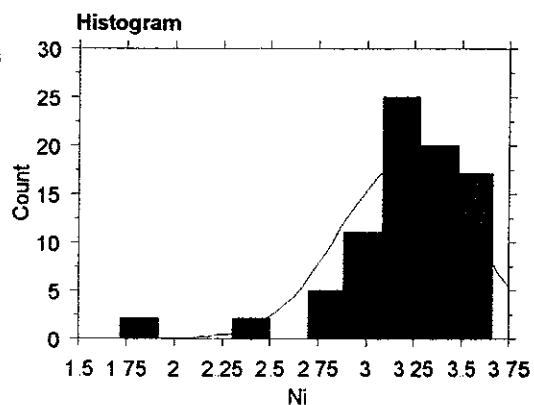
Descriptive Statistics

Molybdenum	
Mean	1.498
Std. Dev.	1.262
Std. Error	.139
Count	82
Minimum	.071
Maximum	6.100
# Missing	0



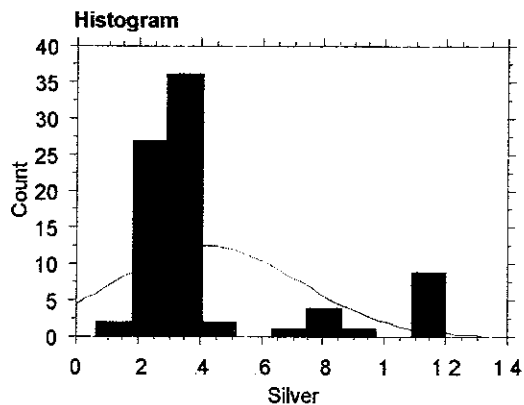
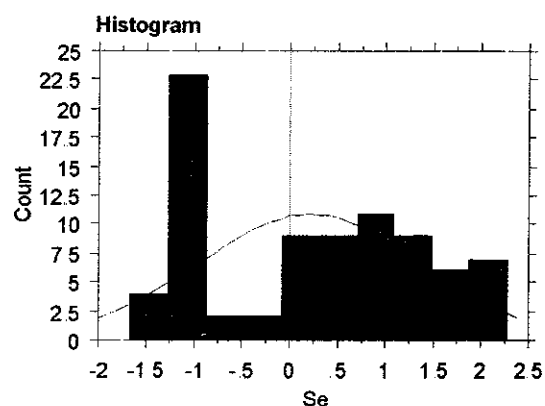
Descriptive Statistics

Nickel	
Mean	25.985
Std. Dev.	7.110
Std. Error	.785
Count	82
Minimum	5.600
Maximum	39.200
# Missing	0



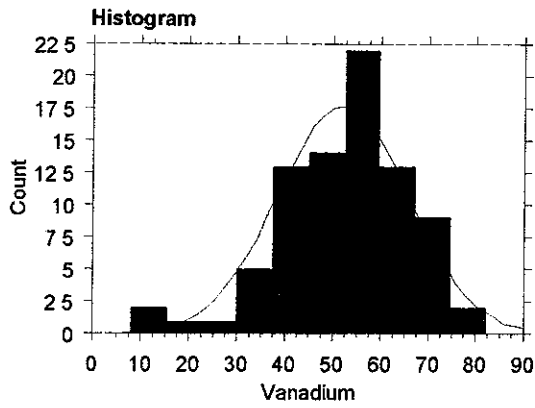
Descriptive Statistics

Selenium	
Mean	2.260
Std. Dev.	2.344
Std. Error	.259
Count	82
Minimum	.190
Maximum	9.700
# Missing	0



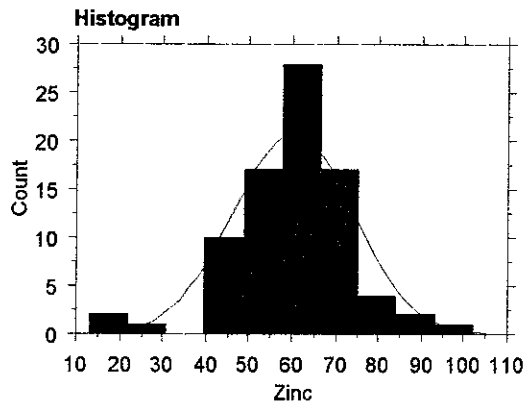
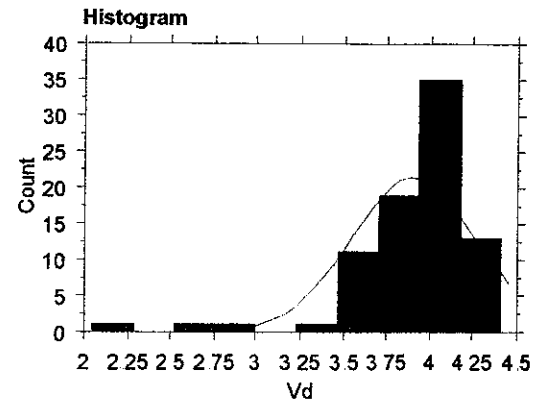
Descriptive Statistics

Silver	
Mean	.426
Std. Dev.	.299
Std. Error	.033
Count	82
Minimum	.065
Maximum	1.200
# Missing	0



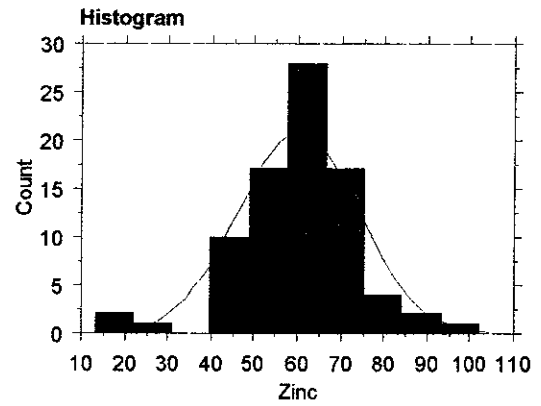
Descriptive Statistics

	Vanadium
Mean	52.122
Std. Dev.	13.718
Std. Error	1.515
Count	82
Minimum	7.800
Maximum	82.000
# Missing	0

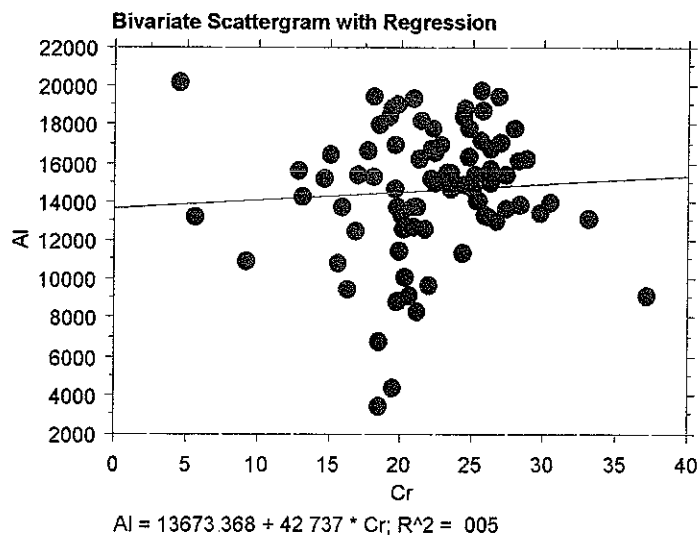
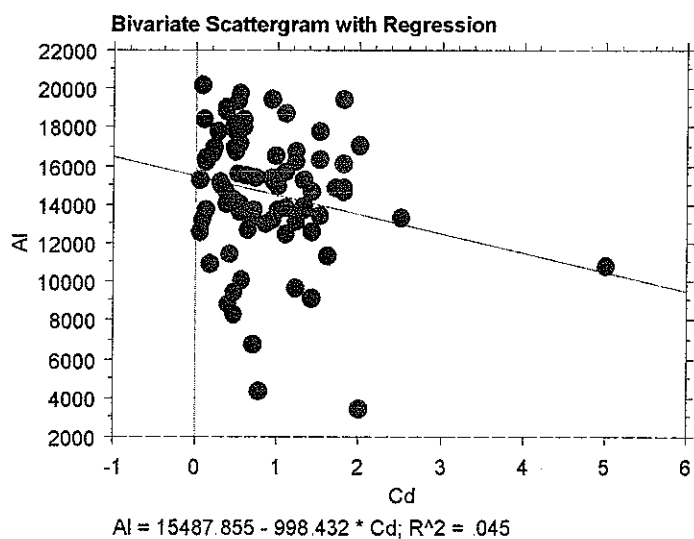
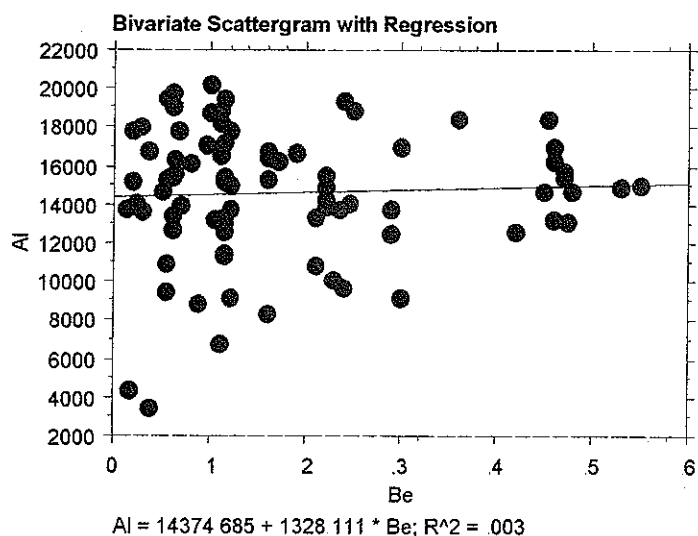
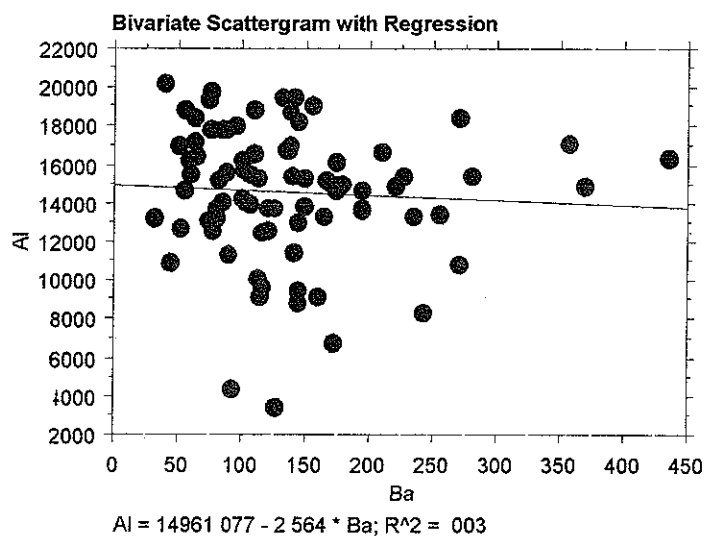
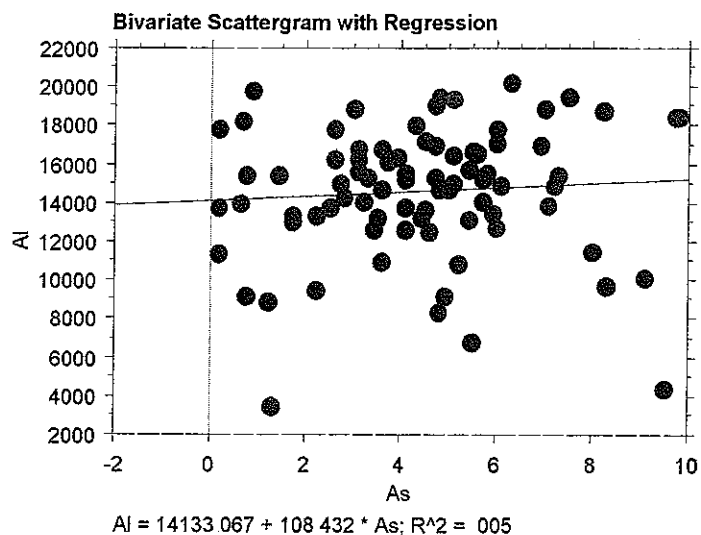
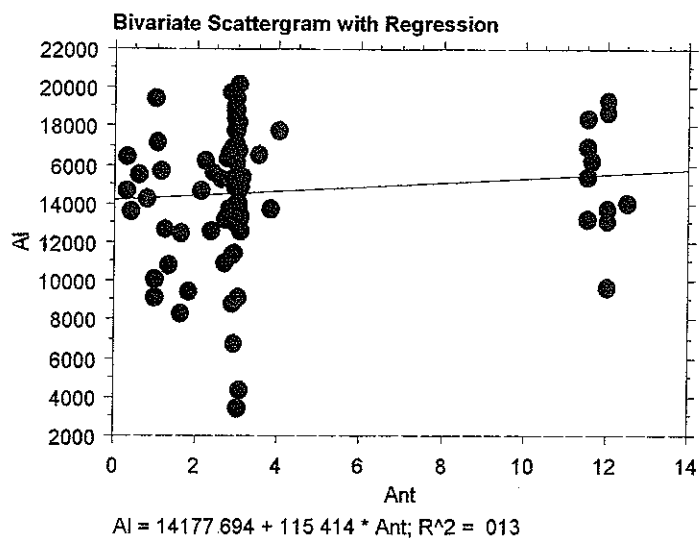


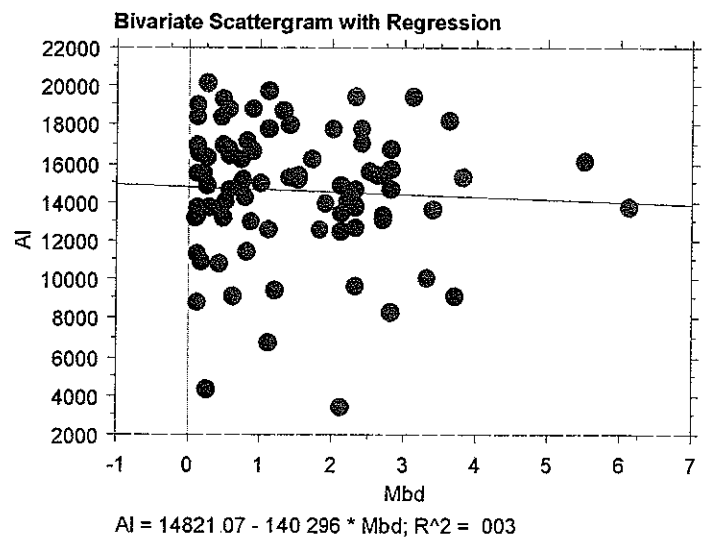
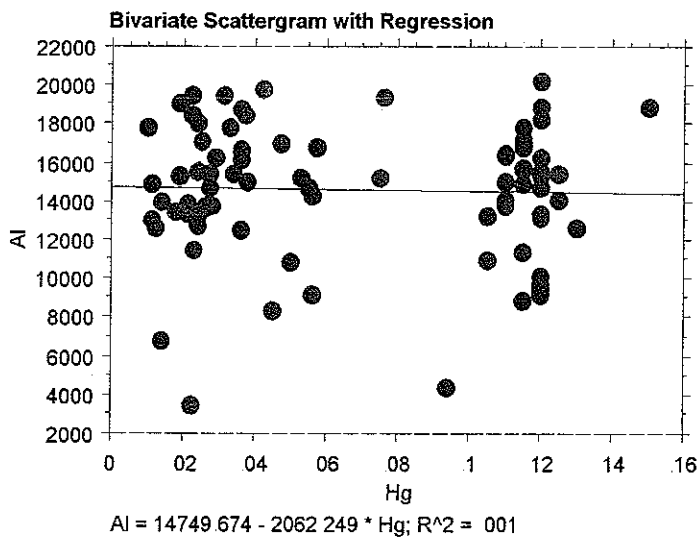
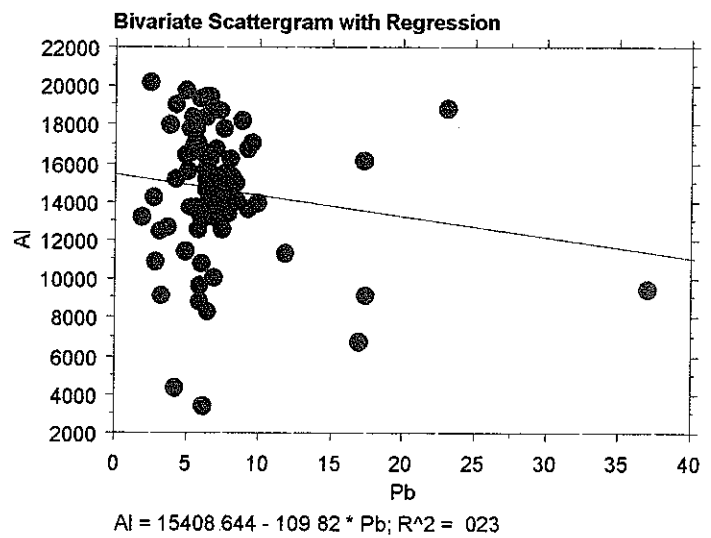
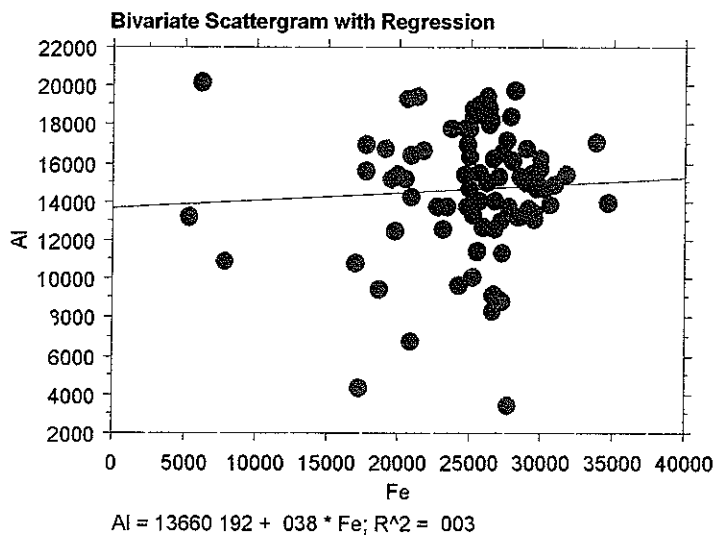
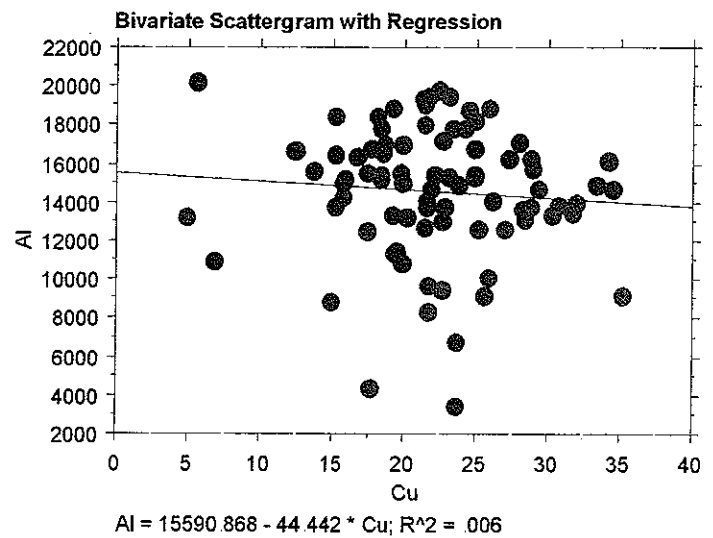
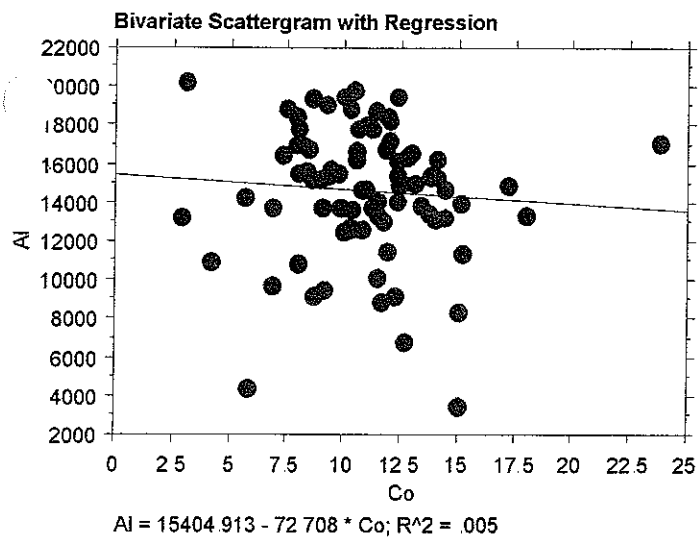
Descriptive Statistics

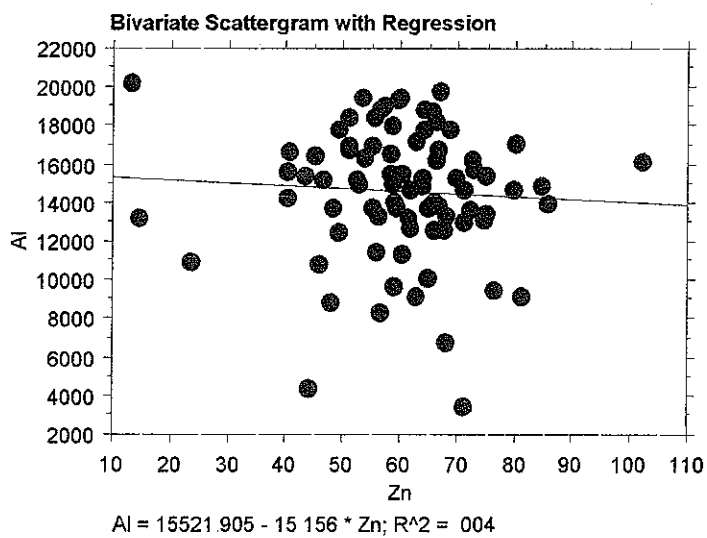
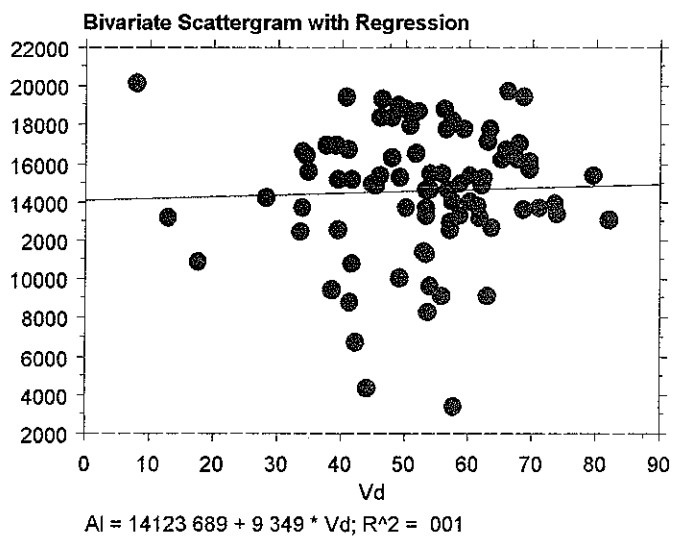
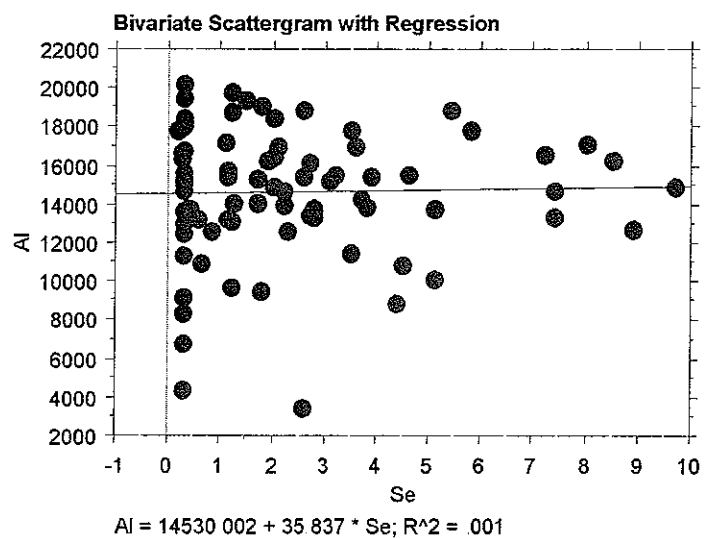
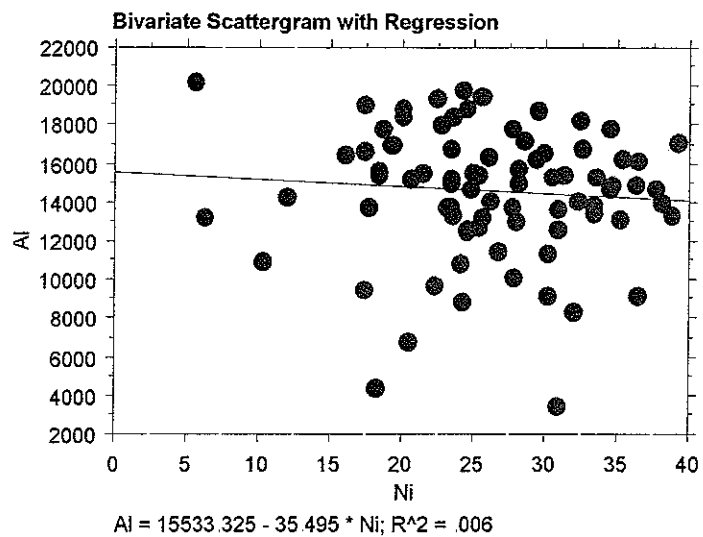
	Zinc
Mean	60.102
Std. Dev.	13.979
Std. Error	1.544
Count	82
Minimum	13.200
Maximum	102.000
# Missing	0

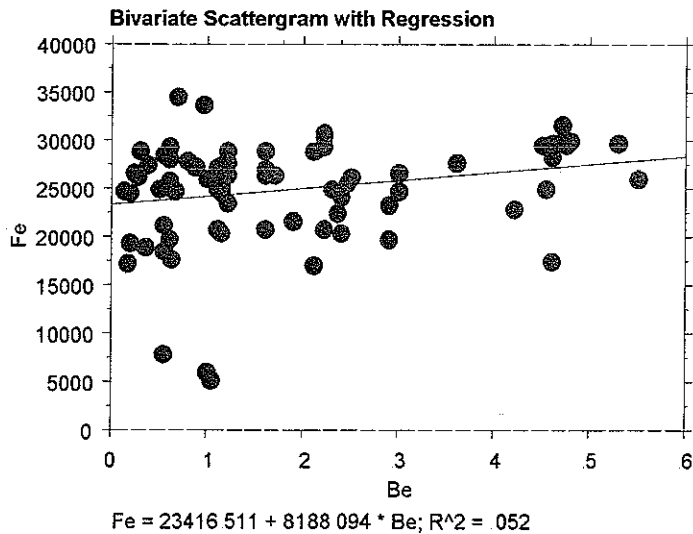
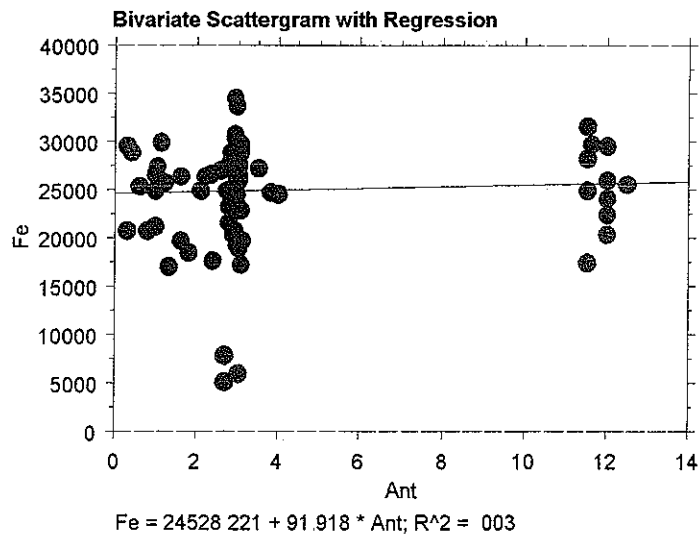
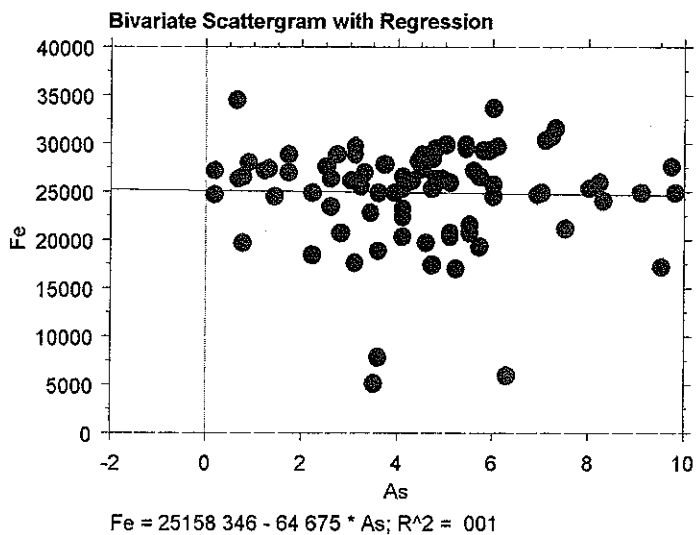
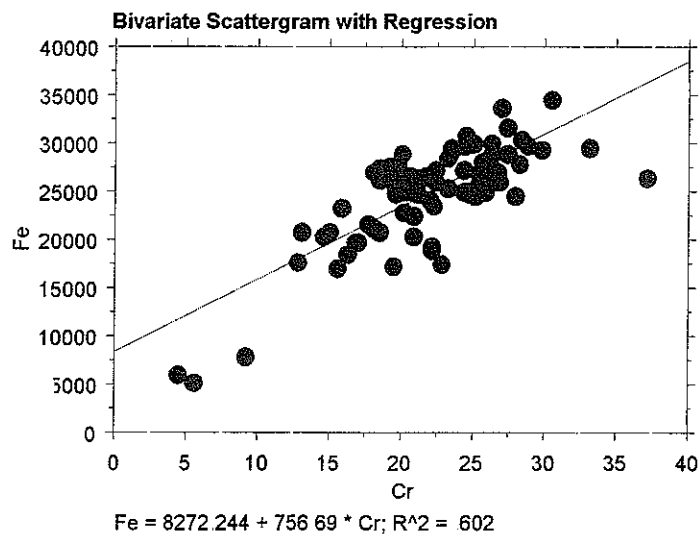
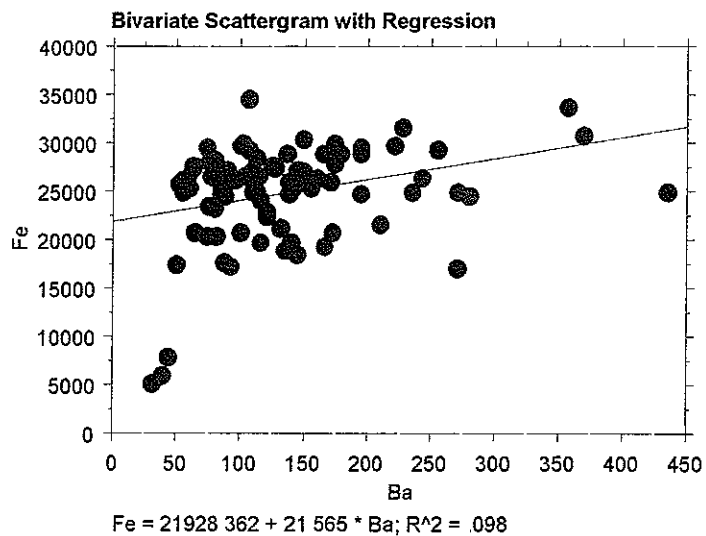
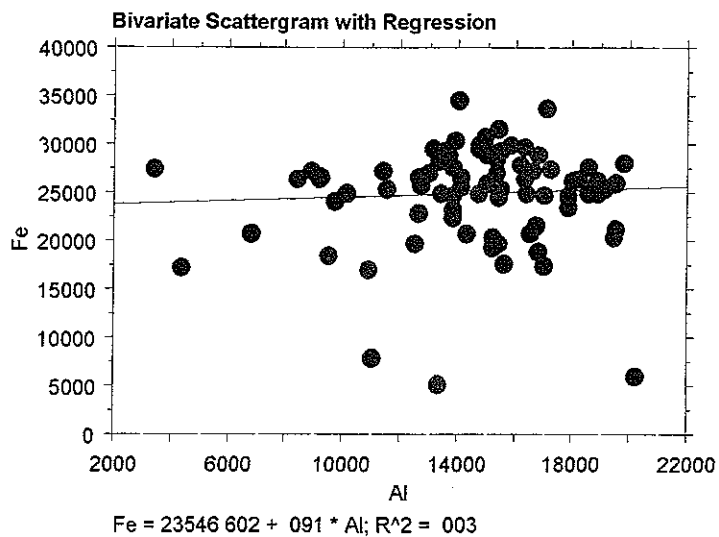


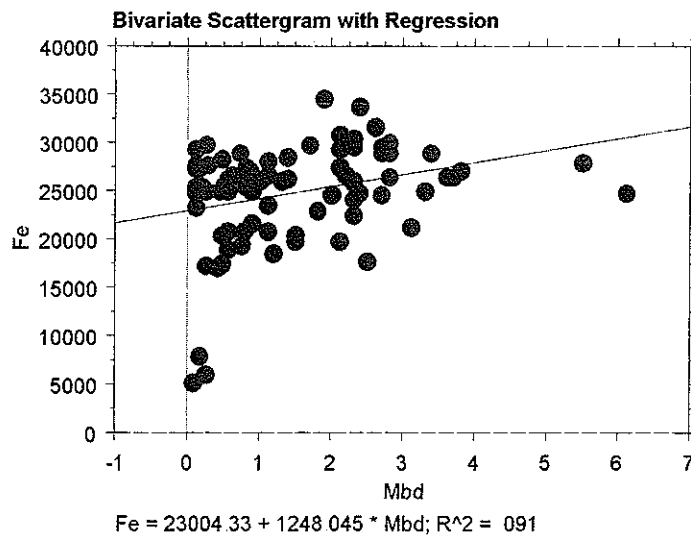
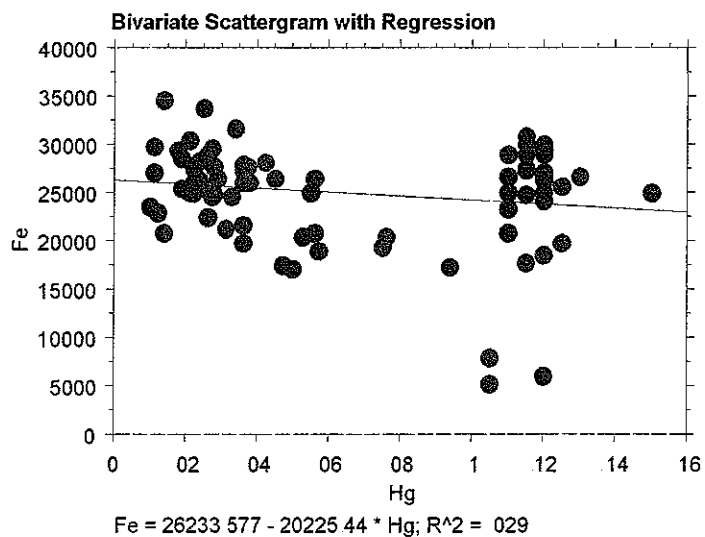
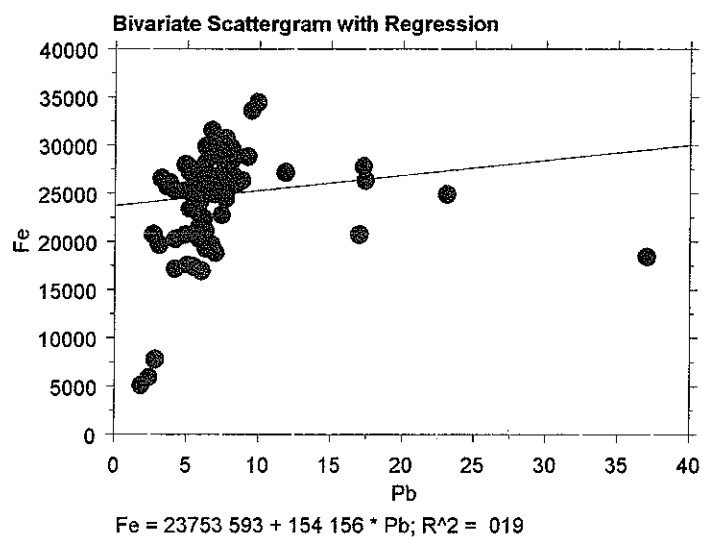
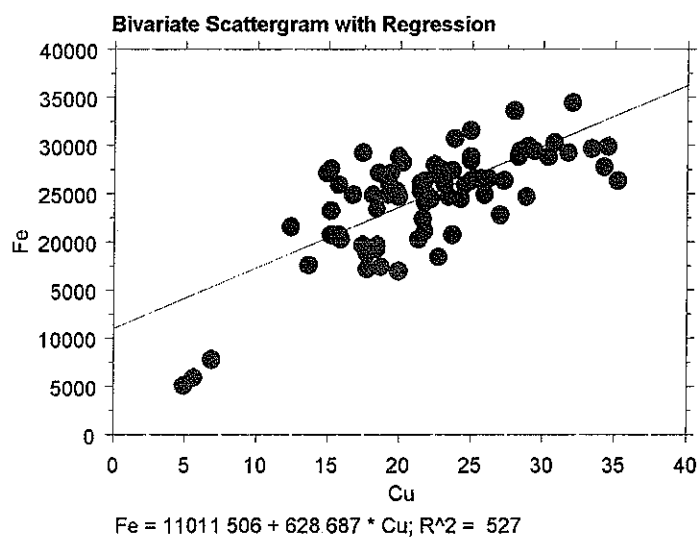
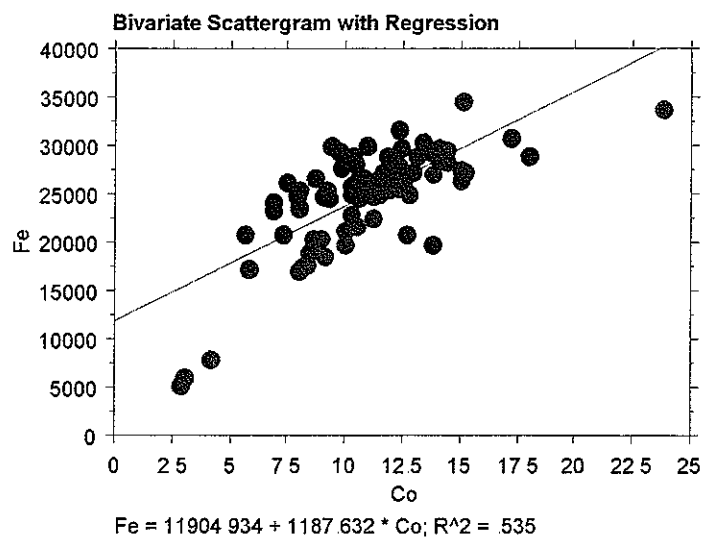
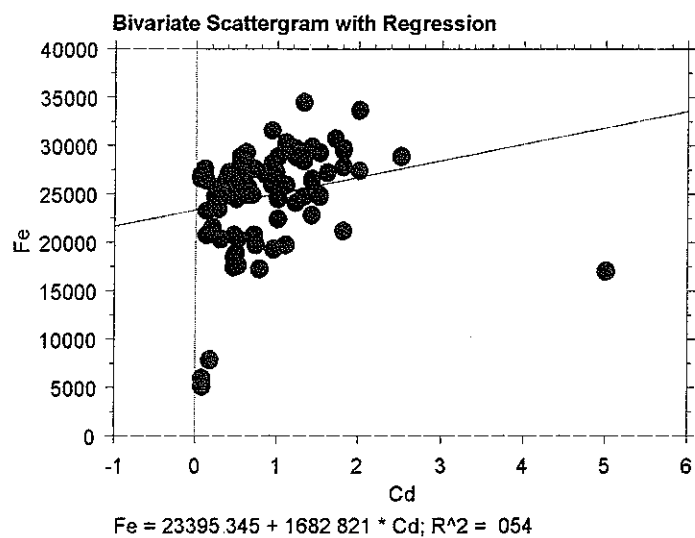
Geochemical Scatterplots versus Aluminum and Iron

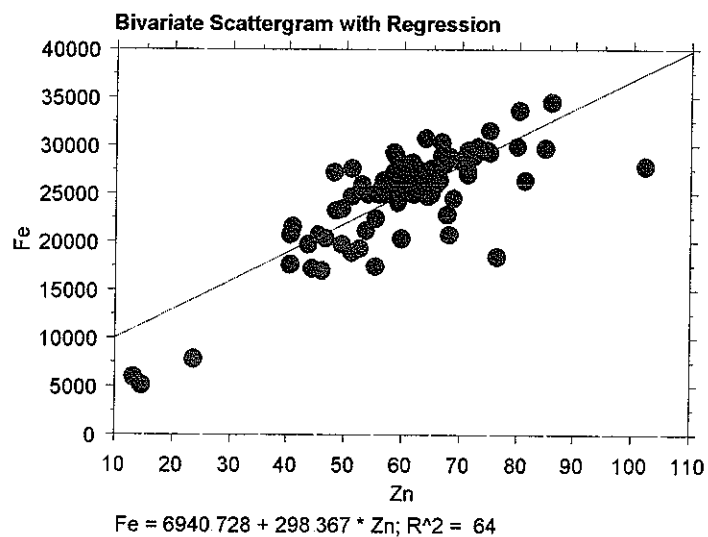
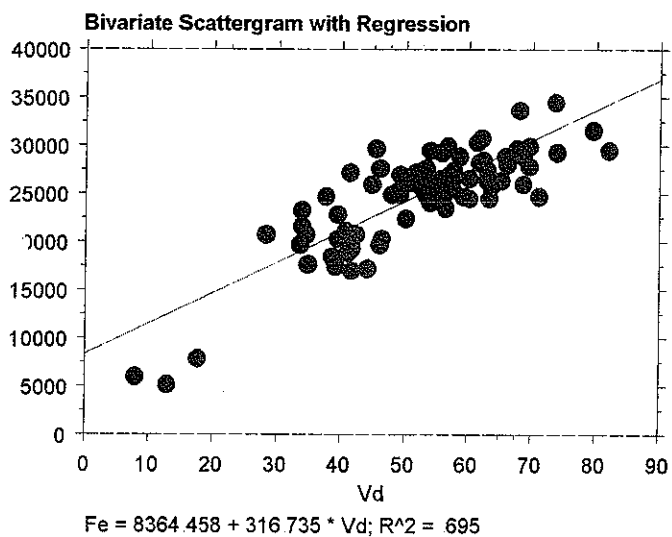
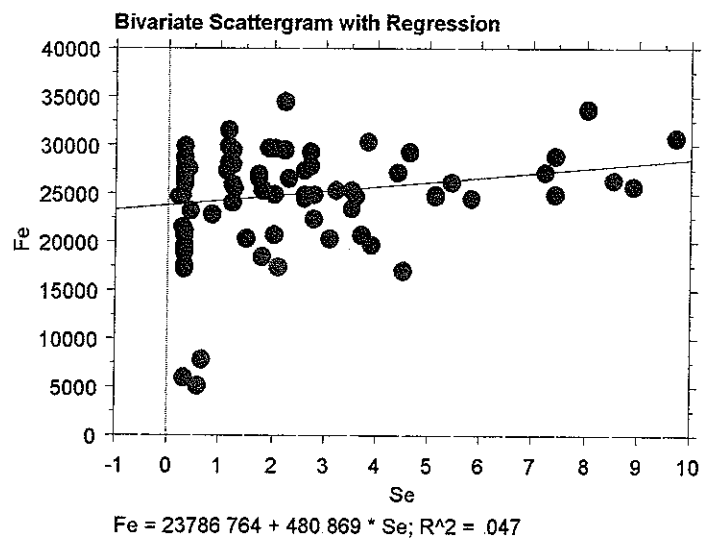
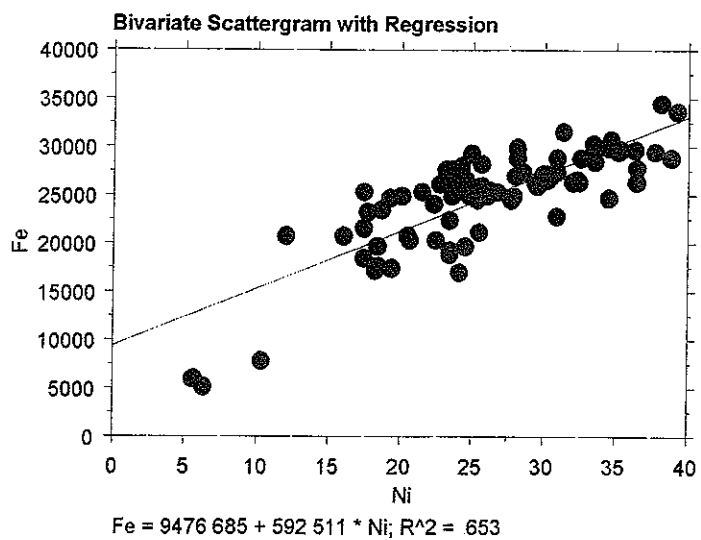




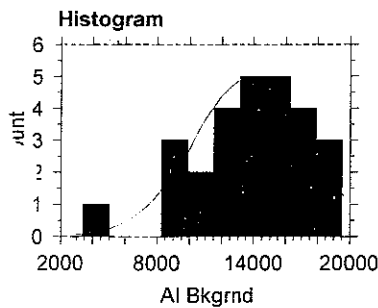






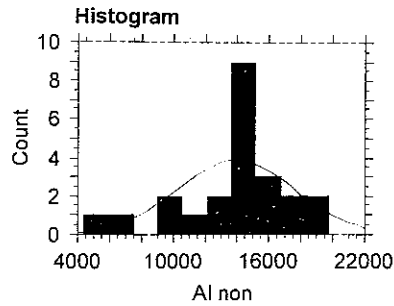


Soil Histograms and Summary Statistics for Grouped Areas



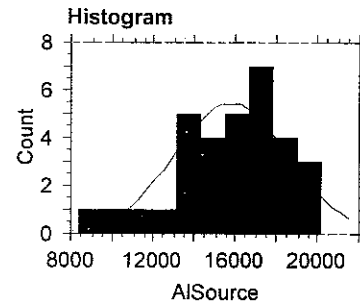
Descriptive Statistics

AI Bkgrnd	
Mean	13784.815
Std Dev	3507.118
Std Error	674.945
Count	27
Minimum	3420.000
Maximum	19500.000
# Missing	0



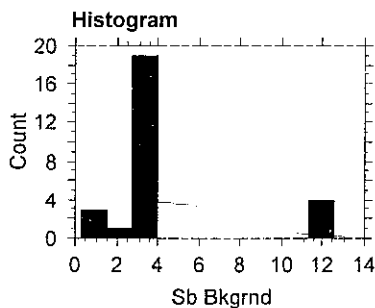
Descriptive Statistics

AI non	
Mean	13930.000
Std Dev	3672.127
Std Error	765.691
Count	23
Minimum	4350.000
Maximum	19800.000
# Missing	9



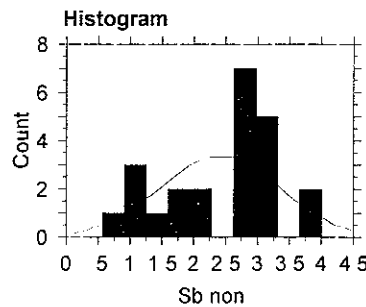
Descriptive Statistics

AISource	
Mean	15797.500
Std Dev	2760.354
Std Error	487.966
Count	32
Minimum	8400.000
Maximum	20200.000
# Missing	0



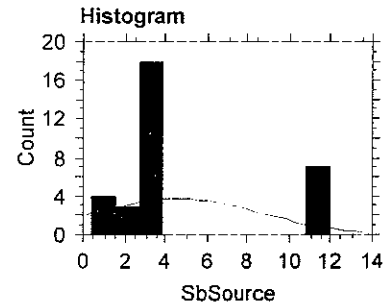
Descriptive Statistics

Sb Bkgrnd	
Mean	3.933
Std Dev	3.475
Std Error	.669
Count	27
Minimum	300
Maximum	12.500
# Missing	0



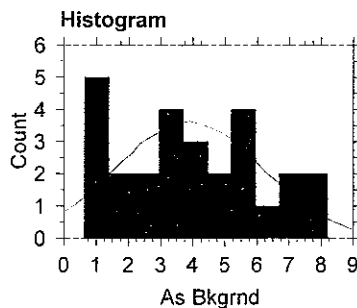
Descriptive Statistics

Sb non	
Mean	2.409
Std Dev	.936
Std Error	.195
Count	23
Minimum	.560
Maximum	4.000
# Missing	9



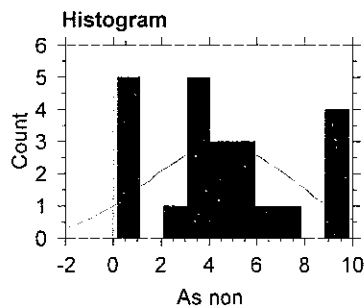
Descriptive Statistics

SbSource	
Mean	4.570
Std Dev	3.950
Std Error	.698
Count	32
Minimum	.370
Maximum	12.000
# Missing	0



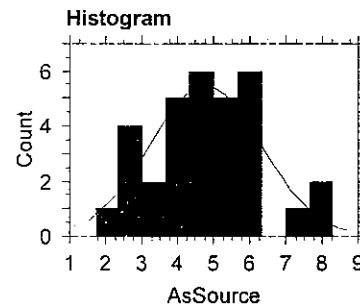
Descriptive Statistics

As Bkgrnd	
Mean	3.879
Std Dev	2.262
Std Error	.435
Count	27
Minimum	640
Maximum	8.200
# Missing	0



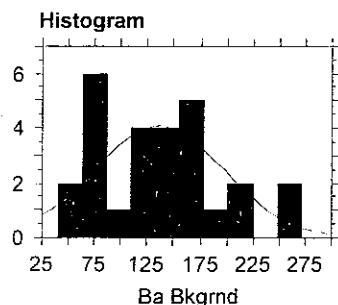
Descriptive Statistics

As non	
Mean	4.507
Std Dev	3.088
Std Error	.644
Count	23
Minimum	.160
Maximum	9.800
# Missing	9



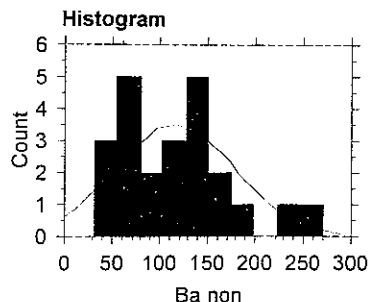
Descriptive Statistics

AsSource	
Mean	4.781
Std Dev	1.546
Std Error	.273
Count	32
Minimum	1.700
Maximum	8.300
# Missing	0



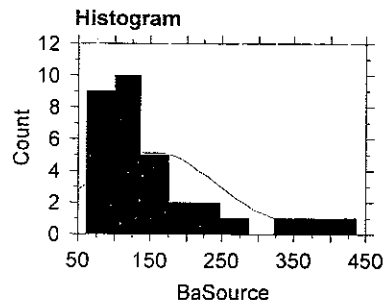
Descriptive Statistics

Ba Bkgrnd	
Mean	136.111
Std Dev	61.318
Std. Error	11.801
Count	27
Minimum	39.600
Maximum	271.000
# Missing	0



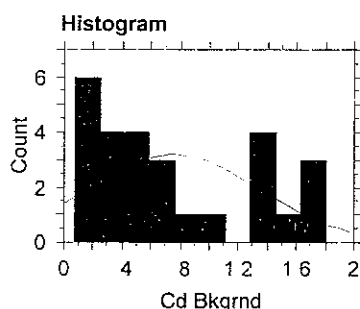
Descriptive Statistics

Ba non	
Mean	115.996
Std Dev	62.938
Std. Error	13.123
Count	23
Minimum	30.500
Maximum	271.000
# Missing	9



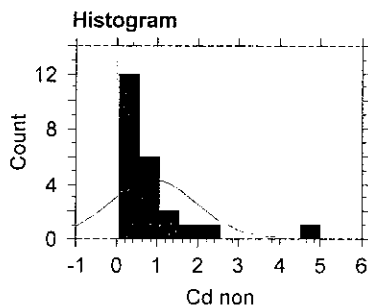
Descriptive Statistics

BaSource	
Mean	151.716
Std Dev	92.168
Std. Error	16.293
Count	32
Minimum	61.900
Maximum	435.000
# Missing	0



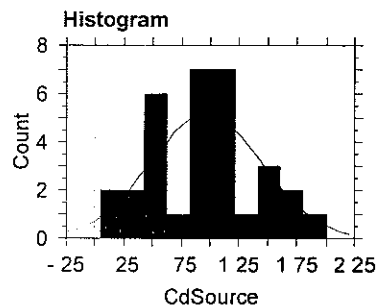
Descriptive Statistics

Cd Bkgrnd	
Mean	.760
Std Dev	.585
Std. Error	.113
Count	27
Minimum	.071
Maximum	1.800
# Missing	0



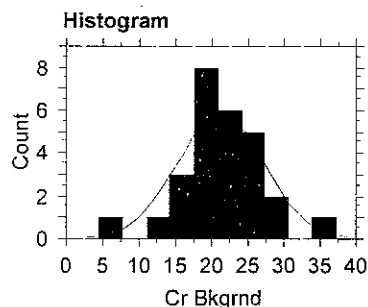
Descriptive Statistics

Cd non	
Mean	.900
Std Dev	1.069
Std. Error	.223
Count	23
Minimum	.065
Maximum	5.000
# Missing	9



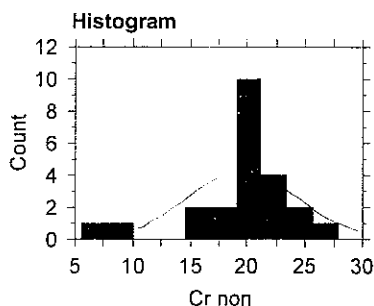
Descriptive Statistics

CdSource	
Mean	.962
Std Dev	.489
Std. Error	.086
Count	32
Minimum	.038
Maximum	2.000
# Missing	0



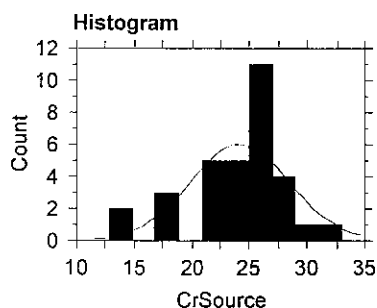
Descriptive Statistics

Cr Bkgrnd	
Mean	21.296
Std Dev	6.001
Std. Error	1.155
Count	27
Minimum	4.500
Maximum	37.100
# Missing	0



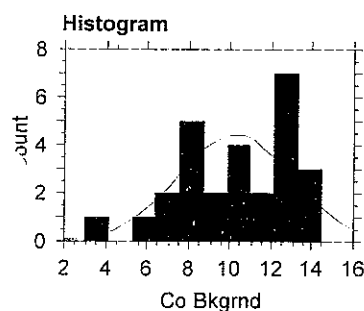
Descriptive Statistics

Cr non	
Mean	19.591
Std Dev	4.798
Std. Error	1.000
Count	23
Minimum	5.600
Maximum	27.900
# Missing	9



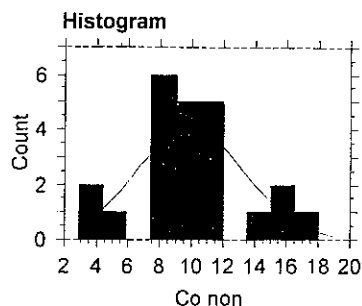
Descriptive Statistics

CrSource	
Mean	24.169
Std Dev	4.308
Std. Error	.762
Count	32
Minimum	12.800
Maximum	33.000
# Missing	0



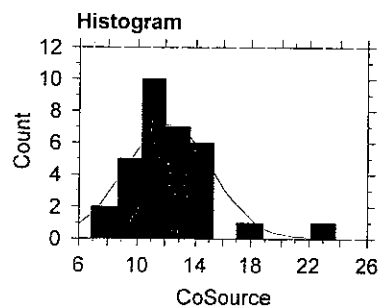
Descriptive Statistics

	Co Bkgrnd
Mean	10.248
Std Dev	2.777
Std. Error	.534
Count	27
Minimum	3.000
Maximum	14.400
# Missing	0



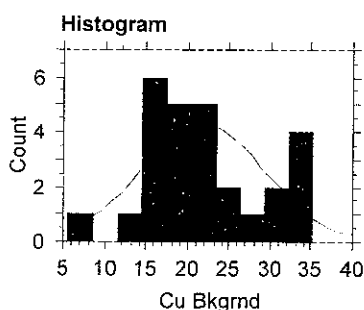
Descriptive Statistics

	Co non
Mean	9.904
Std Dev	3.428
Std. Error	.715
Count	23
Minimum	2.900
Maximum	18.000
# Missing	9



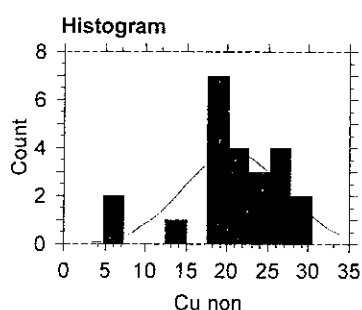
Descriptive Statistics

	CoSource
Mean	12.216
Std Dev	3.044
Std. Error	.538
Count	32
Minimum	6.900
Maximum	23.800
# Missing	0



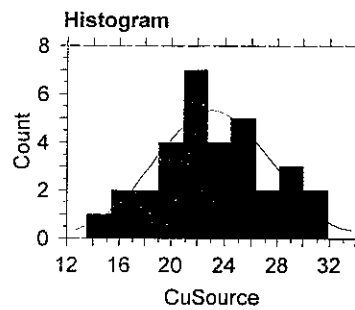
Descriptive Statistics

	Cu Bkgrnd
Mean	21.856
Std Dev	7.453
Std. Error	1.434
Count	27
Minimum	5.600
Maximum	35.200
# Missing	0



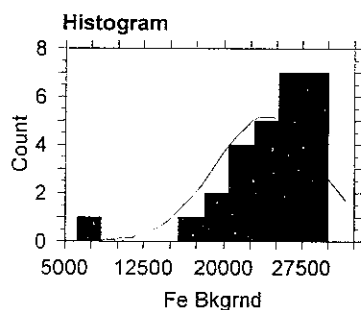
Descriptive Statistics

	Cu non
Mean	20.804
Std Dev	6.100
Std. Error	1.272
Count	23
Minimum	4.800
Maximum	30.300
# Missing	9



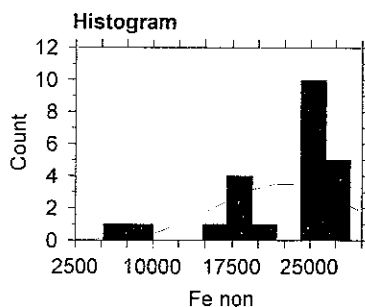
Descriptive Statistics

	CuSource
Mean	23.106
Std Dev	4.405
Std. Error	.779
Count	32
Minimum	13.600
Maximum	31.900
# Missing	0



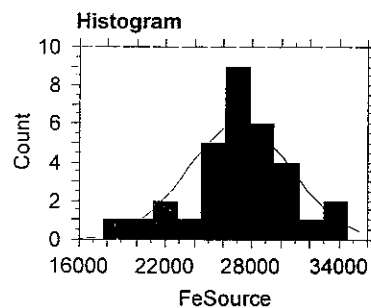
Descriptive Statistics

	Fe Bkgrnd
Mean	24211.852
Std Dev	4979.043
Std. Error	958.217
Count	27
Minimum	6120.000
Maximum	30100.000
# Missing	0



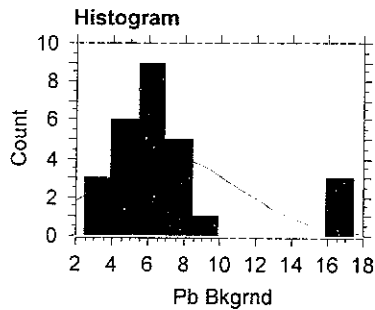
Descriptive Statistics

	Fe non
Mean	22495.217
Std Dev	6203.070
Std. Error	1293.429
Count	23
Minimum	5250.000
Maximum	28900.000
# Missing	9



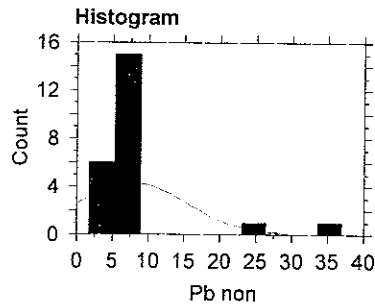
Descriptive Statistics

	FeSource
Mean	27140.625
Std Dev	3610.456
Std. Error	638.244
Count	32
Minimum	17700.000
Maximum	34600.000
# Missing	0



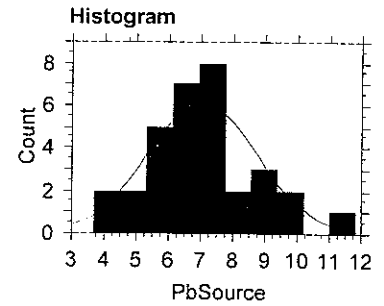
Descriptive Statistics

Pb Bkgrnd	
Mean	7.059
Std Dev	3.976
Std Error	.765
Count	27
Minimum	2.400
Maximum	17.400
# Missing	0



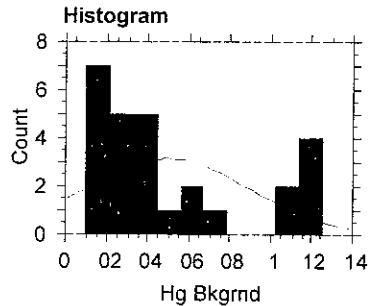
Descriptive Statistics

Pb non	
Mean	7.800
Std Dev	7.494
Std Error	1.563
Count	23
Minimum	1.800
Maximum	37.000
# Missing	9



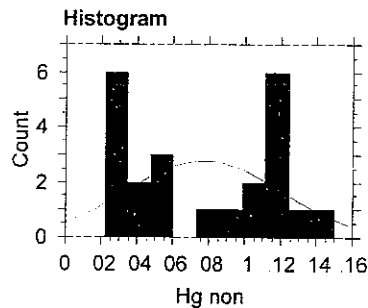
Descriptive Statistics

PbSource	
Mean	7.050
Std Dev	1.693
Std Error	.299
Count	32
Minimum	3.700
Maximum	11.800
# Missing	0



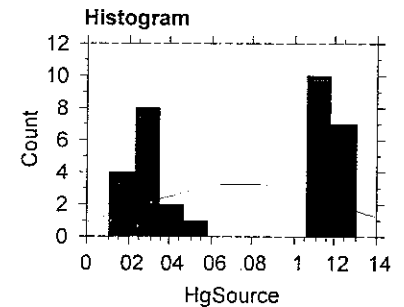
Descriptive Statistics

Hg Bkgrnd	
Mean	.050
Std Dev	.040
Std Error	.008
Count	27
Minimum	.010
Maximum	.125
# Missing	0



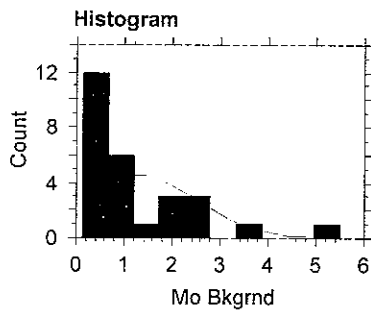
Descriptive Statistics

Hg non	
Mean	.077
Std Dev	.042
Std Error	.009
Count	23
Minimum	.022
Maximum	.150
# Missing	9



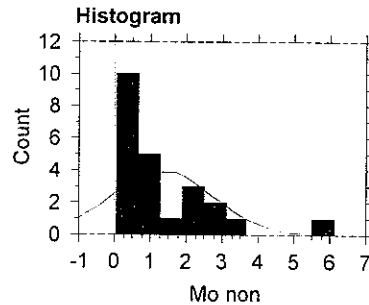
Descriptive Statistics

HgSource	
Mean	.075
Std Dev	.046
Std Error	.008
Count	32
Minimum	.011
Maximum	.130
# Missing	0



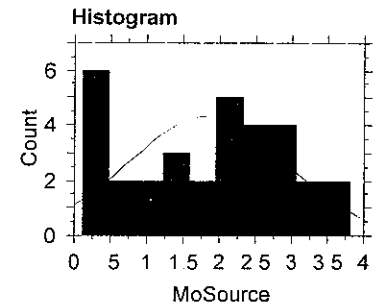
Descriptive Statistics

Mo Bkgrnd	
Mean	1.235
Std Dev	1.273
Std Error	.245
Count	27
Minimum	.110
Maximum	5.500
# Missing	0



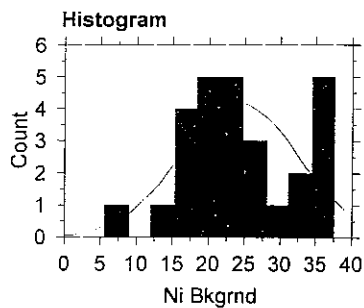
Descriptive Statistics

Mo non	
Mean	1.346
Std Dev	1.409
Std Error	.294
Count	23
Minimum	.071
Maximum	6.100
# Missing	9



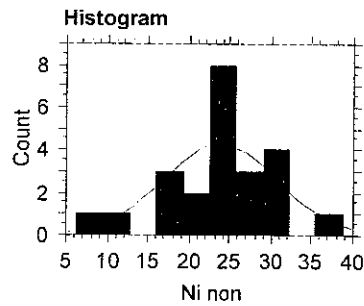
Descriptive Statistics

MoSource	
Mean	1.828
Std Dev	1.098
Std Error	.194
Count	32
Minimum	.115
Maximum	3.800
# Missing	0



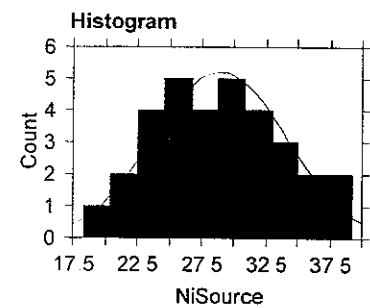
Descriptive Statistics

Ni Bkgnd	
Mean	24.344
Std Dev	8.259
Std Error	1.589
Count	27
Minimum	5.600
Maximum	37.600
# Missing	0



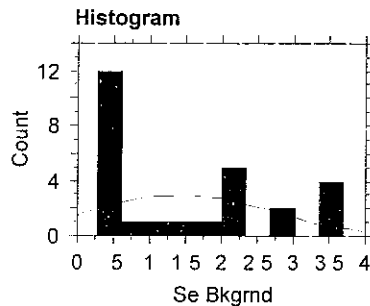
Descriptive Statistics

Ni non	
Mean	23.896
Std Dev	6.971
Std Error	1.454
Count	23
Minimum	6.300
Maximum	38.700
# Missing	9



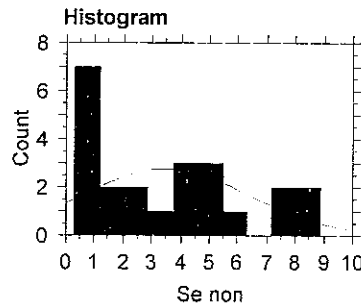
Descriptive Statistics

NiSource	
Mean	28.872
Std Dev	5.118
Std Error	.905
Count	32
Minimum	18.300
Maximum	39.200
# Missing	0



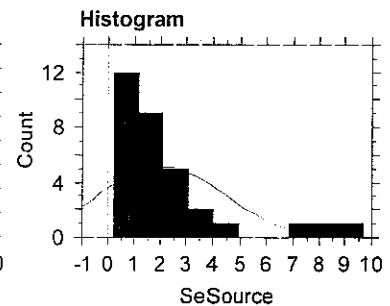
Descriptive Statistics

Se Bkgnd	
Mean	1.449
Std Dev	1.229
Std Error	.236
Count	27
Minimum	.275
Maximum	3.700
# Missing	0



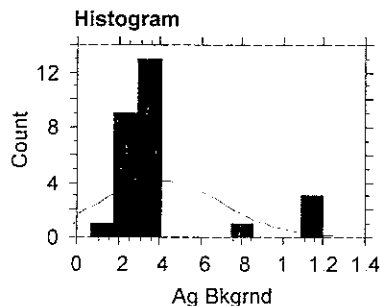
Descriptive Statistics

Se non	
Mean	3.502
Std Dev	2.847
Std Error	.594
Count	23
Minimum	.295
Maximum	8.900
# Missing	9



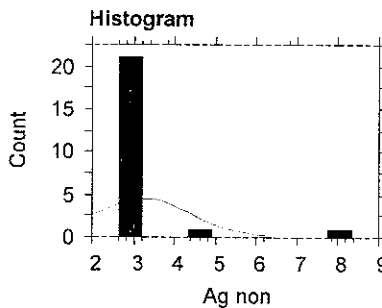
Descriptive Statistics

SeSource	
Mean	2.051
Std Dev	2.362
Std Error	.417
Count	32
Minimum	.190
Maximum	9.700
# Missing	0



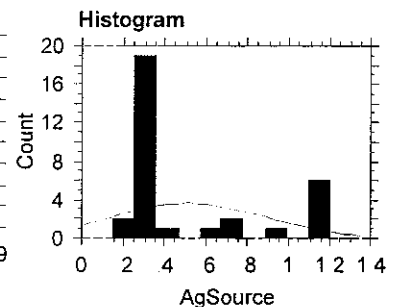
Descriptive Statistics

Ag Bkgnd	
Mean	404
Std Dev	295
Std Error	.057
Count	27
Minimum	.065
Maximum	1.200
# Missing	0



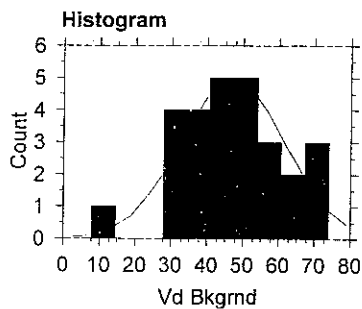
Descriptive Statistics

Ag non	
Mean	.324
Std Dev	.115
Std Error	.024
Count	23
Minimum	.265
Maximum	830
# Missing	9



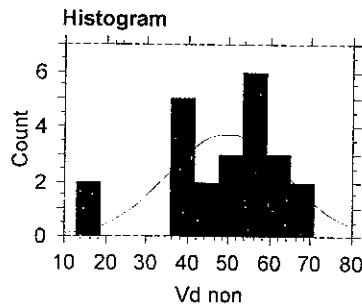
Descriptive Statistics

AgSource	
Mean	.517
Std Dev	.367
Std Error	.065
Count	32
Minimum	.150
Maximum	1.200
# Missing	0



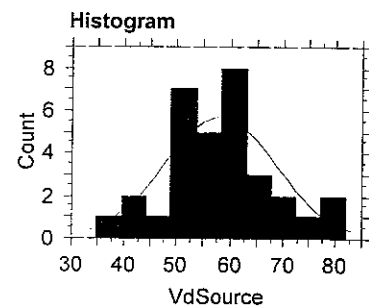
Descriptive Statistics

Vd Bkgnd	
Mean	47.193
Std Dev	14.384
Std Error	2.768
Count	27
Minimum	7.800
Maximum	73.700
# Missing	0



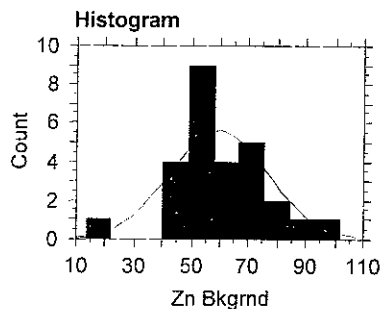
Descriptive Statistics

Vd non	
Mean	49.504
Std Dev	14.174
Std Error	2.956
Count	23
Minimum	12.800
Maximum	70.800
# Missing	9



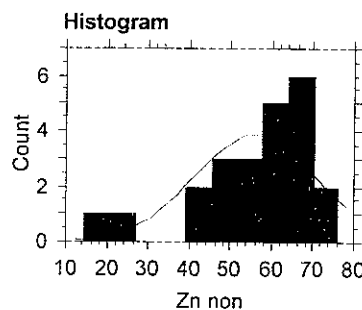
Descriptive Statistics

VdSource	
Mean	58.162
Std Dev	10.569
Std Error	1.868
Count	32
Minimum	34.700
Maximum	82.000
# Missing	0



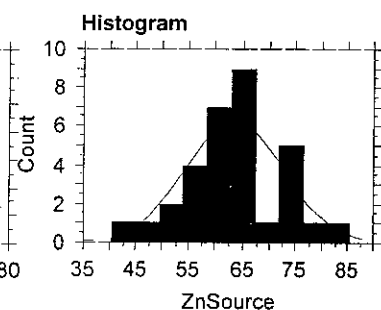
Descriptive Statistics

Zn Bkgnd	
Mean	59.496
Std Dev	17.135
Std Error	3.298
Count	27
Minimum	13.200
Maximum	102.000
# Missing	0



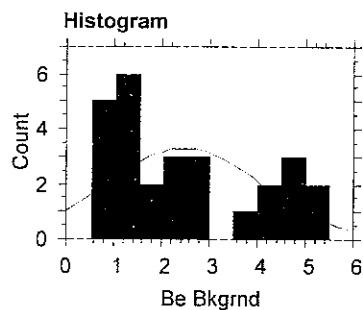
Descriptive Statistics

Zn non	
Mean	55.983
Std Dev	14.677
Std Error	3.060
Count	23
Minimum	14.600
Maximum	76.200
# Missing	9



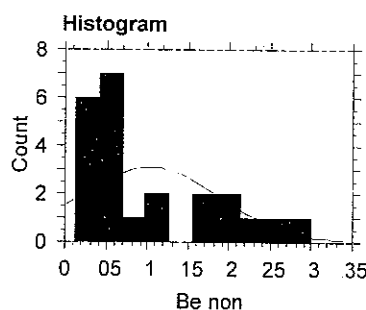
Descriptive Statistics

ZnSource	
Mean	63.575
Std Dev	9.279
Std. Error	1.640
Count	32
Minimum	40.300
Maximum	85.600
# Missing	0



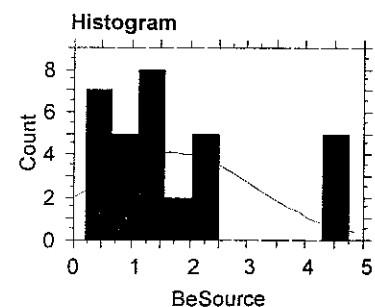
Descriptive Statistics

Be Bkgnd	
Mean	.248
Std Dev	.161
Std Error	.031
Count	27
Minimum	.054
Maximum	.550
# Missing	0



Descriptive Statistics

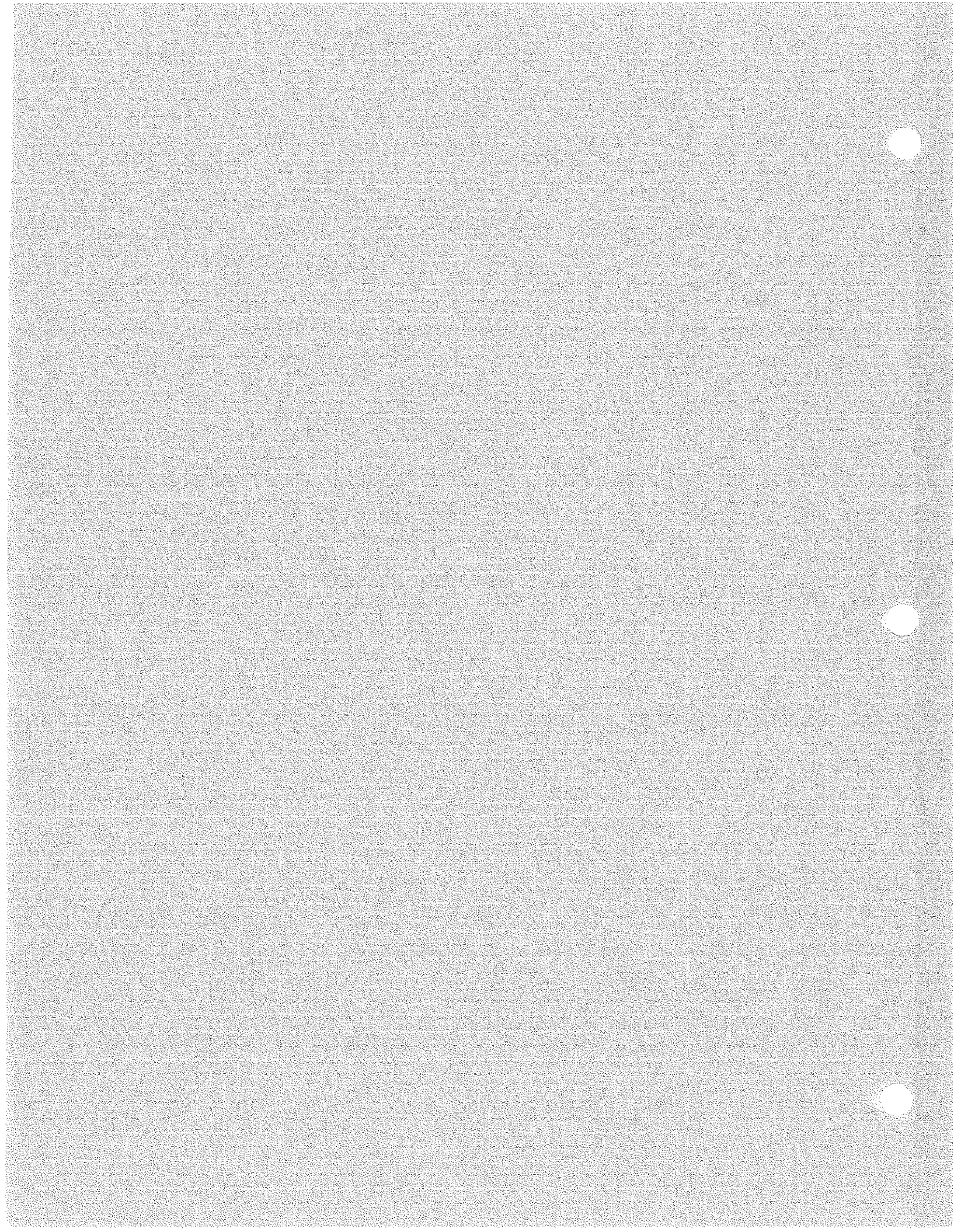
Be non	
Mean	.103
Std Dev	.086
Std Error	.018
Count	23
Minimum	.012
Maximum	.300
# Missing	9



Descriptive Statistics

BeSource	
Mean	.173
Std Dev	.141
Std Error	.025
Count	32
Minimum	.022
Maximum	.475
# Missing	0

Kruskal-Wallis Statistical Test Results

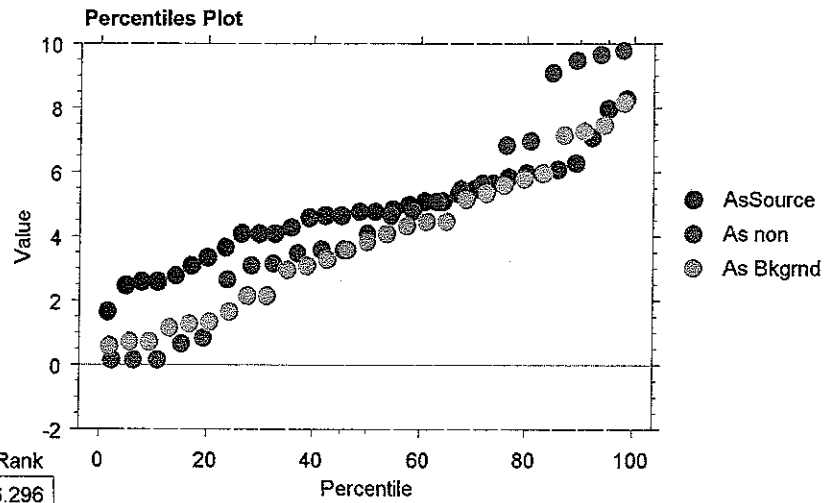


Kruskal-Wallis Test for Arsenic
Grouping Variable: Area

DF	2
# Groups	3
# Ties	16
H	2.648
P-Value	.2660
H corrected for ties	2.650
Tied P-Value	.2658

Kruskal-Wallis Rank Info for Arsenic
Grouping Variable: Area

	Count	Sum Ranks	Mean Rank
As Bkgmd	27	980.000	36.296
As non	23	939.000	40.826
As Source	32	1484.000	46.375



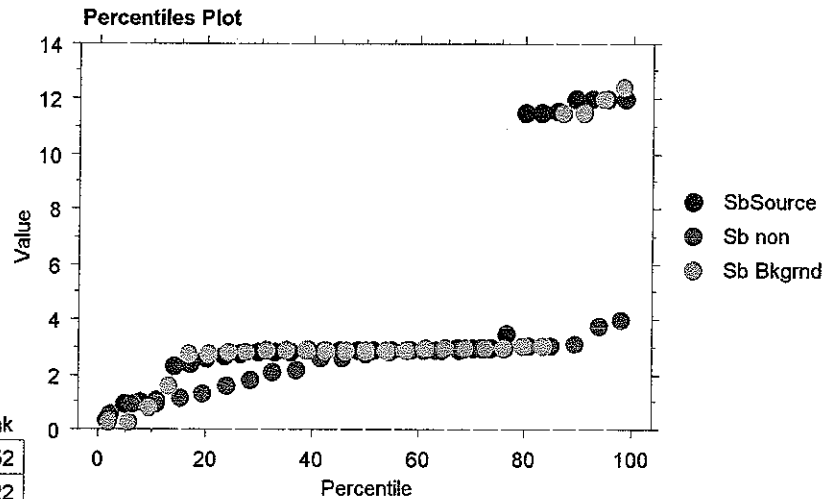
Variables used in this analysis come from datasets of different lengths
Shorter variables may be padded with missing values

Kruskal-Wallis Test for Antimony
Grouping Variable: Areas

DF	2
# Groups	3
# Ties	12
H	2.780
P-Value	.2491
H corrected for ties	2.797
Tied P-Value	.2470

Kruskal-Wallis Rank Info for Antimony
Grouping Variable: Areas

	Count	Sum Ranks	Mean Rank
Bkgmd	27	1211.000	44.852
non	23	794.000	34.522
Source	32	1398.000	43.688



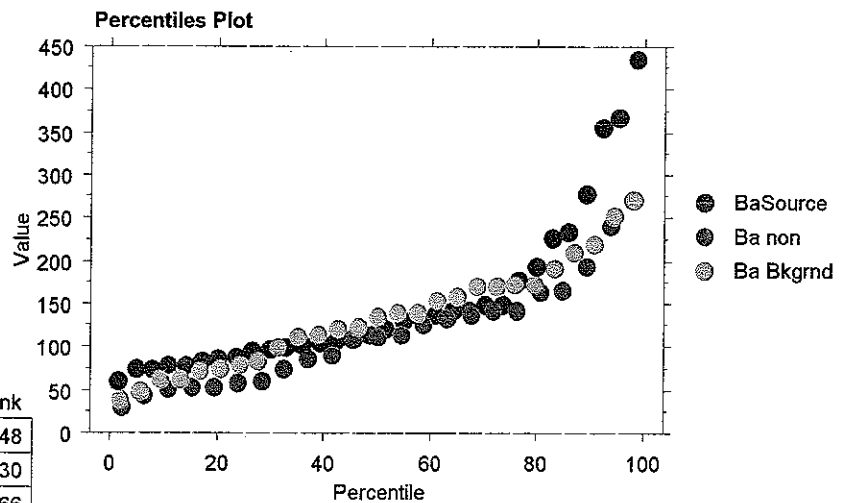
Variables used in this analysis come from datasets of different lengths
Shorter variables may be padded with missing values.

Kruskal-Wallis Test for Barium
Grouping Variable: Areas

DF	2
# Groups	3
# Ties	9
H	2.296
P-Value	.3172
H corrected for ties	2.297
Tied P-Value	.3171

Kruskal-Wallis Rank Info for Barium
Grouping Variable: Areas

	Count	Sum Ranks	Mean Rank
Bkgmd	27	1178.500	43.648
non	23	808.000	35.130
Source	32	1416.500	44.266



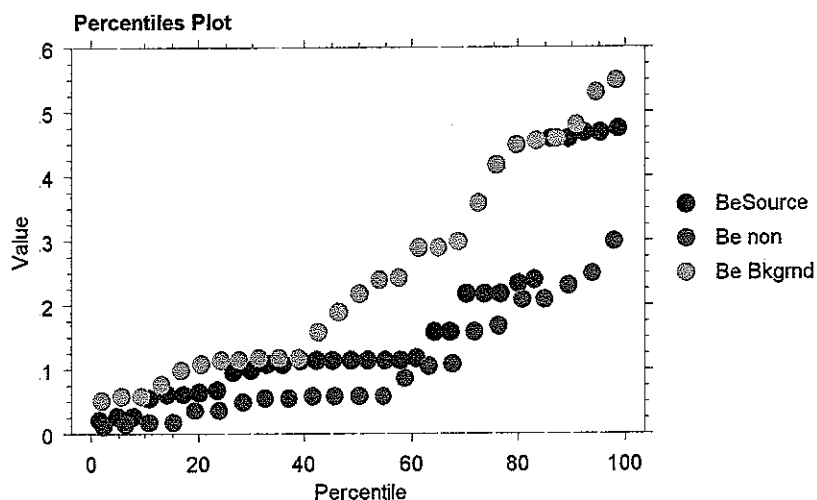
Variables used in this analysis come from datasets of different lengths.
Shorter variables may be padded with missing values

Kruskal-Wallis Test for Beryllium **Grouping Variable: Areas**

DF	2
# Groups	3
# Ties	14
H	14.908
P-Value	.0006
H corrected for ties	14.942
Tied P-Value	.0006

Kruskal-Wallis Rank Info for Beryllium **Grouping Variable: Areas**

	Count	Sum Ranks	Mean Rank
Bkgnd	27	1438.500	53.278
non	23	625.500	27.196
Source	32	1339.000	41.844



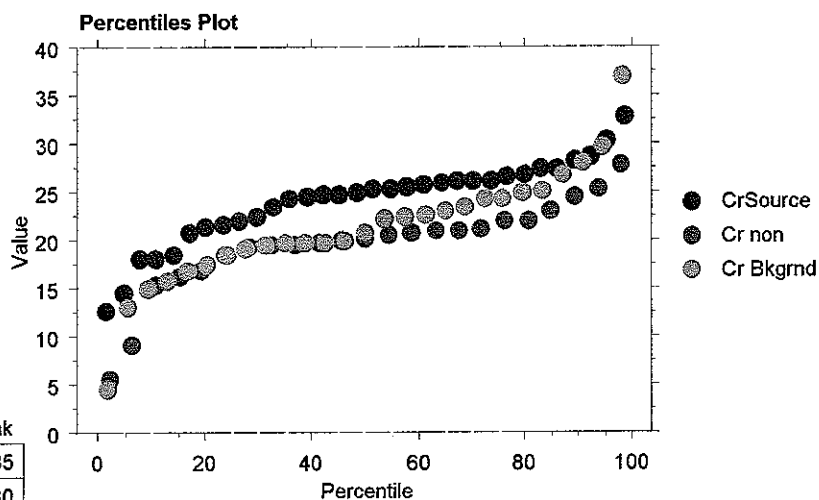
Variables used in this analysis come from datasets of different lengths
Shorter variables may be padded with missing values

Kruskal-Wallis Test for Chromium **Grouping Variable: Areas**

DF	2
# Groups	3
# Ties	16
H	14.001
P-Value	.0009
H corrected for ties	14.005
Tied P-Value	.0009

Kruskal-Wallis Rank Info for Chromium **Grouping Variable: Areas**

	Count	Sum Ranks	Mean Rank
Bkgnd	27	1004.000	37.185
non	23	693.000	30.130
Source	32	1706.000	53.313



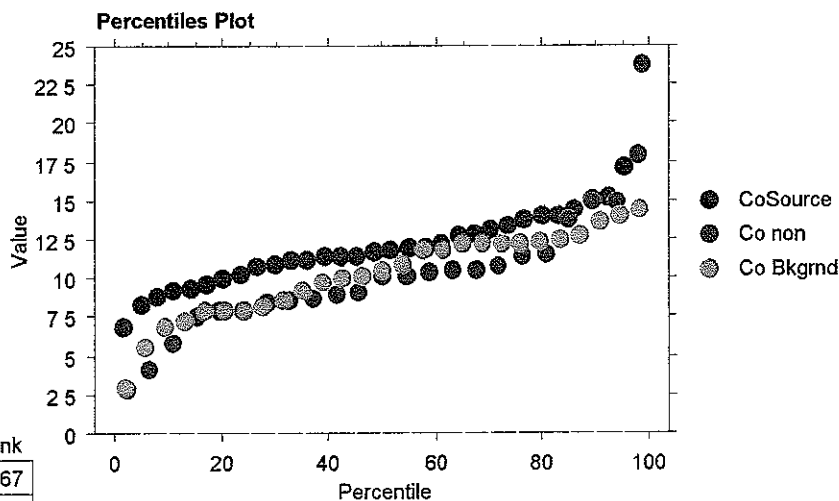
Variables used in this analysis come from datasets of different lengths.
Shorter variables may be padded with missing values

Kruskal-Wallis Test for Cobalt **Grouping Variable: Areas**

DF	2
# Groups	3
# Ties	18
H	8.682
P-Value	.0130
H corrected for ties	8.685
Tied P-Value	.0130

Kruskal-Wallis Rank Info for Cobalt **Grouping Variable: Areas**

	Count	Sum Ranks	Mean Rank
Bkgnd	27	1017.000	37.667
non	23	757.000	32.913
Source	32	1629.000	50.906



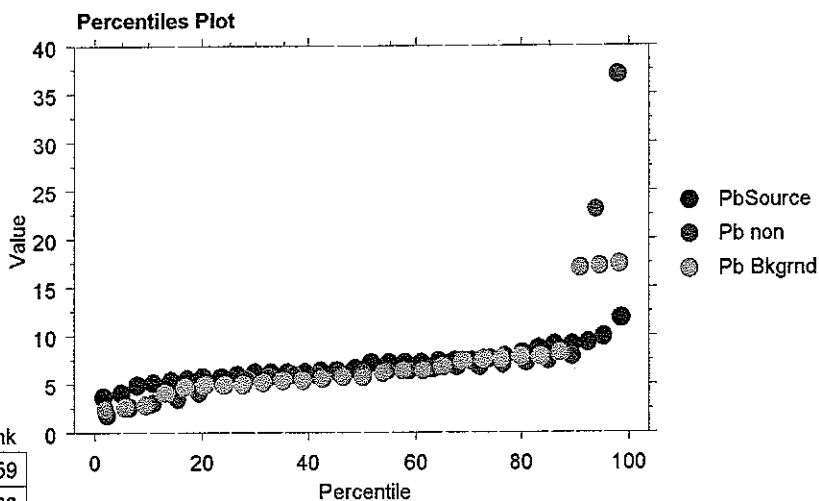
Variables used in this analysis come from datasets of different lengths
Shorter variables may be padded with missing values

Kruskal-Wallis Test for Lead
Grouping Variable: Areas

DF	2
# Groups	3
# Ties	18
H	3.548
P-Value	.1697
H corrected for ties	3.551
Tied P-Value	.1694

Kruskal-Wallis Rank Info for Lead
Grouping Variable: Areas

	Count	Sum Ranks	Mean Rank
Bkgrnd	27	1019.500	37.759
non	23	857.500	37.283
Source	32	1526.000	47.688



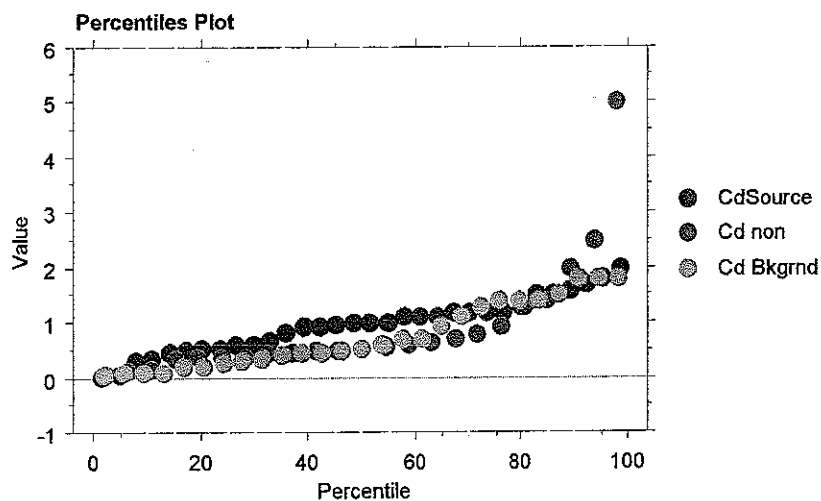
Variables used in this analysis come from datasets of different lengths
Shorter variables may be padded with missing values

Kruskal-Wallis Test for Cadmium
Grouping Variable: Areas

DF	2
# Groups	3
# Ties	16
H	4.062
P-Value	.1312
H corrected for ties	4.065
Tied P-Value	.1310

Kruskal-Wallis Rank Info for Cadmium
Grouping Variable: Areas

	Count	Sum Ranks	Mean Rank
Bkgrnd	27	1008.000	37.333
non	23	855.000	37.174
Source	32	1540.000	48.125



Variables used in this analysis come from datasets of different lengths
Shorter variables may be padded with missing values

Kruskal-Wallis Test for Copper

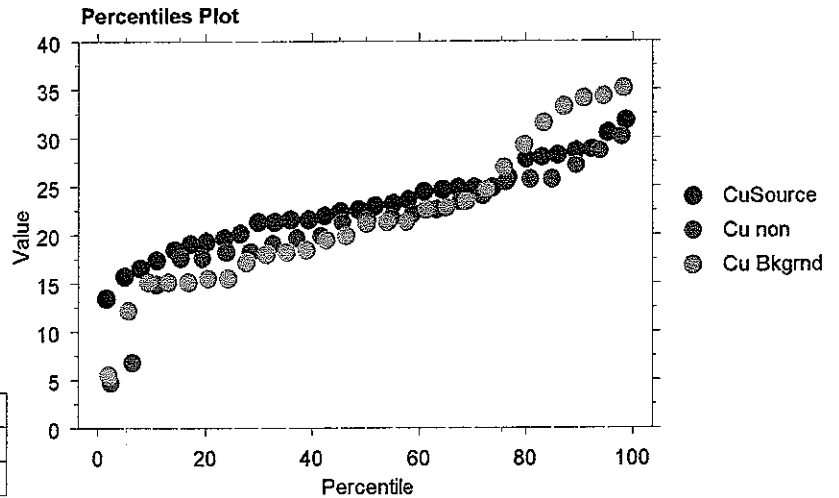
Grouping Variable: Areas

DF	2
# Groups	3
# Ties	14
H	2.213
P-Value	.3307
H corrected for ties	2.214
Tied P-Value	.3306

Kruskal-Wallis Rank Info for Copper

Grouping Variable: Areas

	Count	Sum Ranks	Mean Rank
Bkgrnd	27	1035.000	38.333
non	23	883.500	38.413
Source	32	1484.500	46.391



Variables used in this analysis come from datasets of different lengths
Shorter variables may be padded with missing values.

Kruskal-Wallis Test for Iron

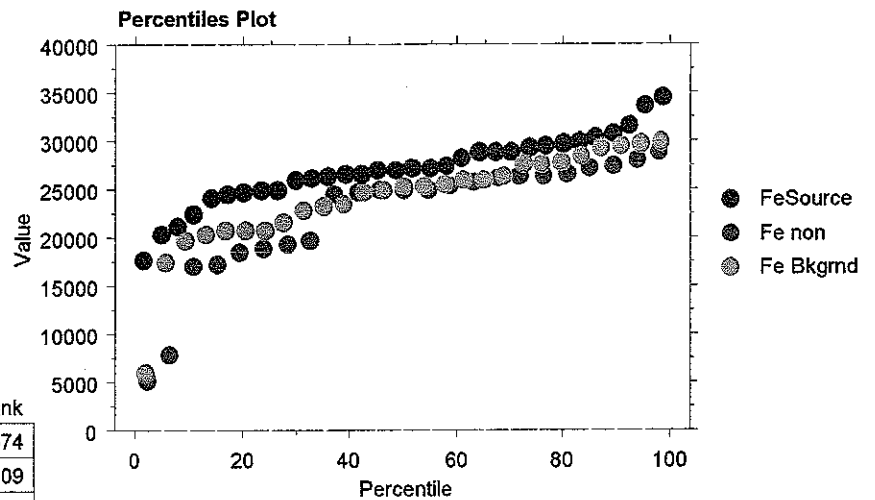
Grouping Variable: Areas

DF	2
# Groups	3
# Ties	11
H	11.671
P-Value	.0029
H corrected for ties	11.675
Tied P-Value	.0029

Kruskal-Wallis Rank Info for Iron

Grouping Variable: Areas

	Count	Sum Ranks	Mean Rank
Bkgrnd	27	1014.500	37.574
non	23	715.500	31.109
Source	32	1673.000	52.281



Variables used in this analysis come from datasets of different lengths
Shorter variables may be padded with missing values.

Kruskal-Wallis Test for Mercury

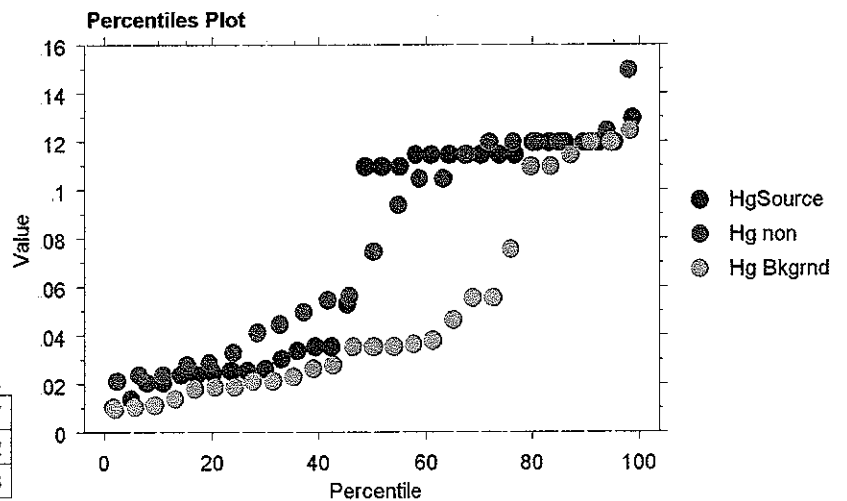
Grouping Variable: Areas

DF	2
# Groups	3
# Ties	16
H	6.598
P-Value	.0369
H corrected for ties	6.637
Tied P-Value	.0362

Kruskal-Wallis Rank Info for Mercury

Grouping Variable: Areas

	Count	Sum Ranks	Mean Rank
Bkgrnd	27	868.500	32.167
non	23	1116.000	48.522
Source	32	1418.500	44.328



Variables used in this analysis come from datasets of different lengths
Shorter variables may be padded with missing values.

Kruskal-Wallis Test for Molybdenum

Grouping Variable: Areas

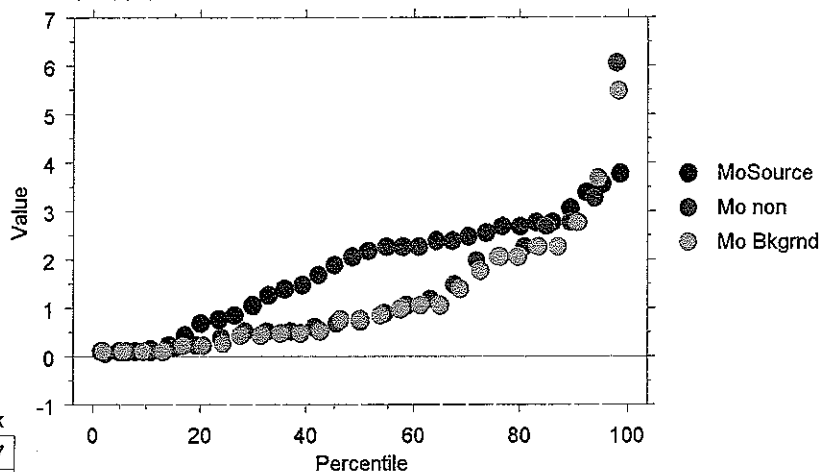
DF	2
# Groups	3
# Ties	15
H	6.326
P-Value	.0423
H corrected for ties	6.334
Tied P-Value	.0421

Kruskal-Wallis Rank Info for Molybdenum

Grouping Variable: Areas

	Count	Sum Ranks	Mean Rank
Bkgrnd	27	949.500	35.167
non	23	863.500	37.543
Source	32	1590.000	49.688

Percentiles Plot



Variables used in this analysis come from datasets of different lengths.
Shorter variables may be padded with missing values.

Kruskal-Wallis Test for Nickel

Grouping Variable: Areas

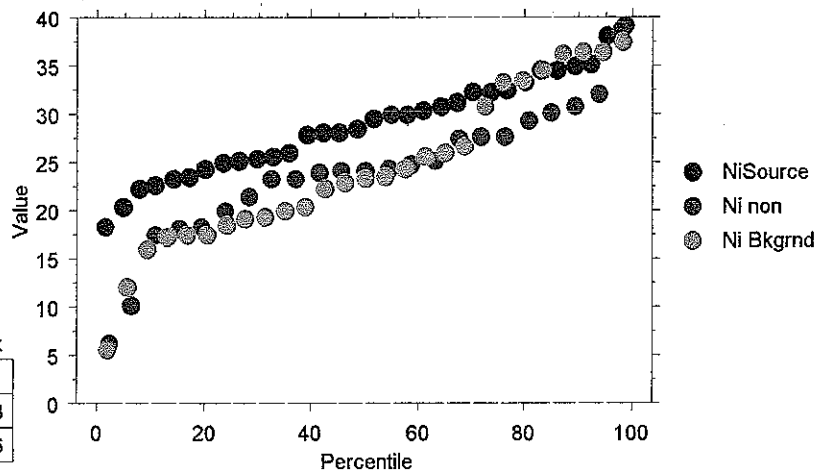
DF	2
# Groups	3
# Ties	12
H	9.310
P-Value	.0095
H corrected for ties	9.312
Tied P-Value	.0095

Kruskal-Wallis Rank Info for Nickel

Grouping Variable: Areas

	Count	Sum Ranks	Mean Rank
Bkgrnd	27	961.500	35.611
non	23	793.000	34.478
Source	32	1648.500	51.516

Percentiles Plot



Variables used in this analysis come from datasets of different lengths.
Shorter variables may be padded with missing values

Kruskal-Wallis Test for Selenium

Grouping Variable: Areas

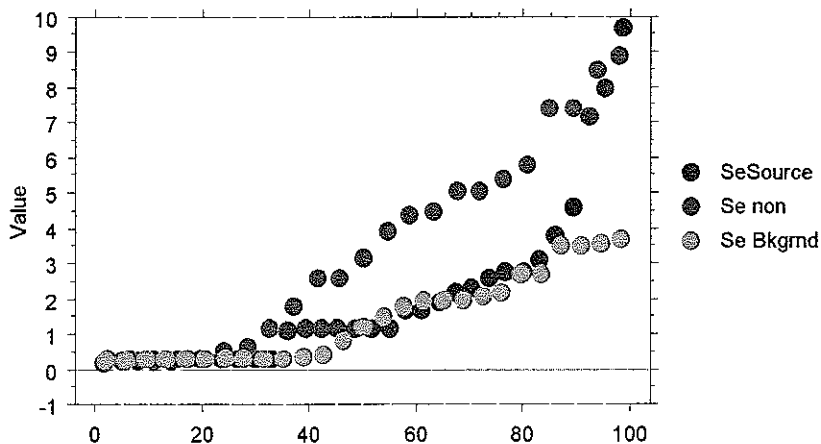
DF	2
# Groups	3
# Ties	17
H	8.528
P-Value	.0141
H corrected for ties	8.542
Tied P-Value	.0140

Kruskal-Wallis Rank Info for Selenium

Grouping Variable: Areas

	Count	Sum Ranks	Mean Rank
Bkgrnd	27	970.000	35.926
non	23	1236.500	53.761
Source	32	1196.500	37.391

Percentiles Plot



Percentile

Variables used in this analysis come from datasets of different lengths
Shorter variables may be padded with missing values

Kruskal-Wallis Test for Silver

Grouping Variable: Areas

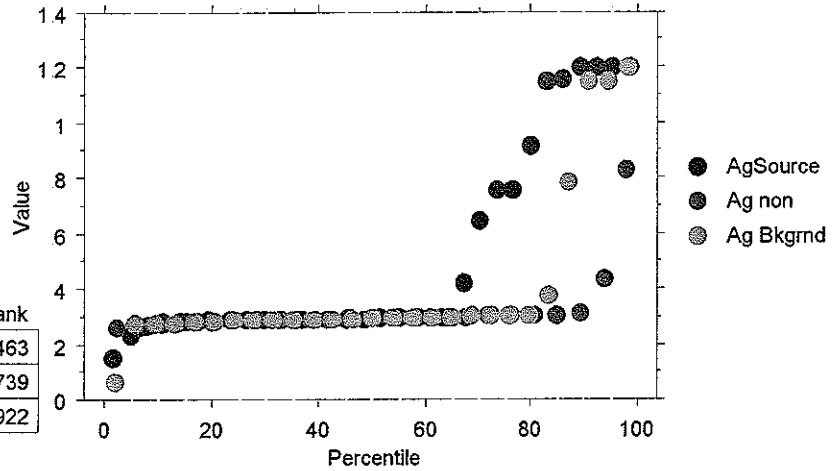
DF	2
# Groups	3
# Ties	11
H	.189
P-Value	.9099
H corrected for ties	.191
Tied P-Value	.9087

Kruskal-Wallis Rank Info for Silver

Grouping Variable: Areas

	Count	Sum Ranks	Mean Rank
Bkgrnd	27	1092.500	40.463
non	23	937.000	40.739
Source	32	1373.500	42.922

Percentiles Plot



Variables used in this analysis come from datasets of different lengths
Shorter variables may be padded with missing values

Kruskal-Wallis Test for Vanadium

Grouping Variable: Areas

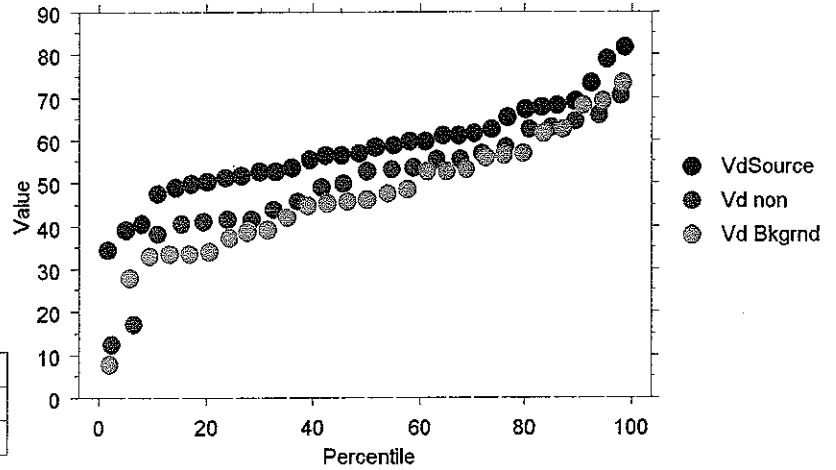
DF	2
# Groups	3
# Ties	7
H	10.412
P-Value	.0055
H corrected for ties	10.412
Tied P-Value	.0055

Kruskal-Wallis Rank Info for Vanadium

Grouping Variable: Areas

	Count	Sum Ranks	Mean Rank
Bkgrnd	27	869.000	32.185
non	23	880.000	38.261
Source	32	1654.000	51.688

Percentiles Plot



Variables used in this analysis come from datasets of different lengths
Shorter variables may be padded with missing values

Kruskal-Wallis Test for Zinc

Grouping Variable: Areas

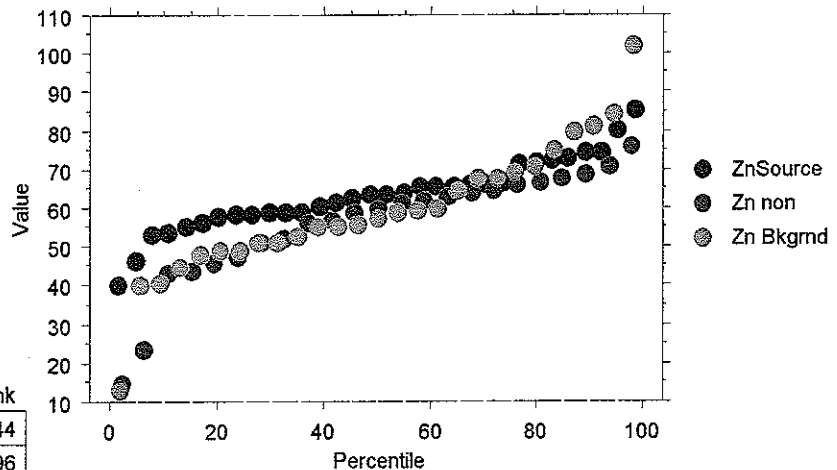
DF	2
# Groups	3
# Ties	4
H	3.433
P-Value	.1797
H corrected for ties	3.433
Tied P-Value	.1797

Kruskal-Wallis Rank Info for Zinc

Grouping Variable: Areas

	Count	Sum Ranks	Mean Rank
Bkgrnd	27	1038.000	38.444
non	23	844.000	36.696
Source	32	1521.000	47.531

Percentiles Plot



Variables used in this analysis come from datasets of different lengths
Shorter variables may be padded with missing values

Groundwater Sample Results - Metals

SAMPLE ID NUMBER	TYPE	SAMPLE DATE	ANALYTE	RESULT	Qualifier	UNIT
00RC-MW07-WF-1-23	REG	2/1/2000	ALUMINUM	131	J	ug/L
00RC-GG11-WF-1-29	REG	1/27/2000	ALUMINUM	124	U	ug/L
99RC-GG02-WF-1-26 7	REG	11/2/1999	ALUMINUM	87 8	U	ug/L
00RC-GG10-WF-1-29	REG	1/27/2000	ALUMINUM	82	U	ug/L
99RC-GG03-WF-1-26 7	REG	11/2/1999	ALUMINUM	65 1	U	ug/L
00RC-GG09-WF-1-25	REG	1/25/2000	ALUMINUM	47	J	ug/L
99RC-MW04B-WF-1-30	REG	11/16/1999	ALUMINUM	29 6	U	ug/L
99RC-MW05-WF-1-22	REG	11/16/1999	ALUMINUM	23 3	U	ug/L
99RC-MW01-WF-1-27	REG	11/16/1999	ALUMINUM	21 8	U	ug/L
00RC-MW02-WF-1-28	REG	2/1/2000	ALUMINUM	21 7	UJ	ug/L
99RC-GG01-WF-1-26 7	REG	11/3/1999	ALUMINUM	19 3	U	ug/L
99RC-MW02-WF-1-28	REG	11/16/1999	ALUMINUM	12 4	UJ	ug/L
99RC-MW03-WF-1-29	REG	11/16/1999	ALUMINUM		U	ug/L
00RC-MW01-WF-1-27	REG	2/1/2000	ALUMINUM		UJ	ug/L
00RC-MW05-WF-1-22	REG	2/1/2000	ALUMINUM		U	ug/L
00RC-MW06-WF-1-22	REG	2/1/2000	ALUMINUM		UJ	ug/L

SAMPLE ID NUMBER	TYPE	SAMPLE DATE	ANALYTE	RESULT	Qualifier	UNIT
00RC-MW07-WF-1-23	REG	2/1/2000	ANTIMONY	11.3		ug/L
99RC-GG03-WF-1-26.7	REG	11/2/1999	ANTIMONY	7.8	U	ug/L
00RC-MW05-WF-1-22	REG	2/1/2000	ANTIMONY	5.3	U	ug/L
00RC-GG10-WF-1-29	REG	1/27/2000	ANTIMONY	4.5	U	ug/L
00RC-MW06-WF-1-22	REG	2/1/2000	ANTIMONY	2.8	J	ug/L
00RC-GG09-WF-1-25	REG	1/25/2000	ANTIMONY	2.6	J	ug/L
99RC-MW05-WF-1-22	REG	11/16/1999	ANTIMONY		U	ug/L
99RC-MW04B-WF-1-30	REG	11/16/1999	ANTIMONY		U	ug/L
99RC-MW03-WF-1-29	REG	11/16/1999	ANTIMONY		U	ug/L
99RC-MW02-WF-1-28	REG	11/16/1999	ANTIMONY		U	ug/L
99RC-MW01-WF-1-27	REG	11/16/1999	ANTIMONY		U	ug/L
99RC-GG02-WF-1-26.7	REG	11/2/1999	ANTIMONY		U	ug/L
99RC-GG01-WF-1-26.7	REG	11/3/1999	ANTIMONY		U	ug/L
00RC-GG11-WF-1-29	REG	1/27/2000	ANTIMONY		U	ug/L
00RC-MW01-WF-1-27	REG	2/1/2000	ANTIMONY		UJ	ug/L
00RC-MW02-WF-1-28	REG	2/1/2000	ANTIMONY		U	ug/L

SAMPLE ID NUMBER	TYPE	SAMPLE DATE	ANALYTE	RESULT	Qualifier	UNIT
99RC-MW03-WF-1-29	REG	11/16/1999	ARSENIC	14.5	U	ug/L
99RC-GG03-WF-1-26.7	REG	11/2/1999	ARSENIC	11.2		ug/L
00RC-MW07-WF-1-23	REG	2/1/2000	ARSENIC	9.4		ug/L
99RC-MW02-WF-1-28	REG	11/16/1999	ARSENIC	7.7	UJ	ug/L
99RC-MW05-WF-1-22	REG	11/16/1999	ARSENIC	7.2	U	ug/L
99RC-MW04B-WF-1-30	REG	11/16/1999	ARSENIC	5.7	U	ug/L
00RC-MW06-WF-1-22	REG	2/1/2000	ARSENIC	5.2		ug/L
99RC-GG02-WF-1-26.7	REG	11/2/1999	ARSENIC	3.1	U	ug/L
00RC-GG11-WF-1-29	REG	1/27/2000	ARSENIC	2.8	U	ug/L
99RC-GG01-WF-1-26.7	REG	11/3/1999	ARSENIC	2.7	U	ug/L
00RC-GG09-WF-1-25	REG	1/25/2000	ARSENIC	2.6	U	ug/L
00RC-MW05-WF-1-22	REG	2/1/2000	ARSENIC	2	U	ug/L
99RC-MW01-WF-1-27	REG	11/16/1999	ARSENIC		U	ug/L
00RC-GG10-WF-1-29	REG	1/27/2000	ARSENIC		U	ug/L
00RC-MW01-WF-1-27	REG	2/1/2000	ARSENIC		UJ	ug/L
00RC-MW02-WF-1-28	REG	2/1/2000	ARSENIC		U	ug/L

SAMPLE ID NUMBER	TYPE	SAMPLE DATE	ANALYTE	RESULT	Qualifier	UNIT
99RC-GG02-WF-1-26.7	REG	11/2/1999	BARIUM	445		ug/L
99RC-GG01-WF-1-26.7	REG	11/3/1999	BARIUM	433		ug/L
99RC-GG03-WF-1-26.7	REG	11/2/1999	BARIUM	219		ug/L
00RC-GG11-WF-1-29	REG	1/27/2000	BARIUM	112		ug/L
00RC-GG09-WF-1-25	REG	1/25/2000	BARIUM	80.4		ug/L
99RC-MW03-WF-1-29	REG	11/16/1999	BARIUM	77.7		ug/L
00RC-GG10-WF-1-29	REG	1/27/2000	BARIUM	43.4		ug/L
99RC-MW02-WF-1-28	REG	11/16/1999	BARIUM	34.1		ug/L
00RC-MW02-WF-1-28	REG	2/1/2000	BARIUM	32.8		ug/L
00RC-MW01-WF-1-27	REG	2/1/2000	BARIUM	26.1	J	ug/L
00RC-MW07-WF-1-23	REG	2/1/2000	BARIUM	25.7		ug/L
99RC-MW01-WF-1-27	REG	11/16/1999	BARIUM	23.4		ug/L
00RC-MW05-WF-1-22	REG	2/1/2000	BARIUM	20.8		ug/L
99RC-MW05-WF-1-22	REG	11/16/1999	BARIUM	18.3		ug/L
99RC-MW04B-WF-1-30	REG	11/16/1999	BARIUM	17.4		ug/L
00RC-MW06-WF-1-22	REG	2/1/2000	BARIUM	14.6		ug/L

SAMPLE ID NUMBER	TYPE	SAMPLE DATE	ANALYTE	RESULT	Qualifier	UNIT
99RC-GG01-WF-1-26.7	REG	11/3/1999	BERYLLIUM	0.079	U	ug/L
99RC-MW02-WF-1-28	REG	11/16/1999	BERYLLIUM	0.06	UJ	ug/L
99RC-MW05-WF-1-22	REG	11/16/1999	BERYLLIUM		U	ug/L
99RC-MW04B-WF-1-30	REG	11/16/1999	BERYLLIUM		U	ug/L
99RC-MW03-WF-1-29	REG	11/16/1999	BERYLLIUM		U	ug/L
99RC-MW01-WF-1-27	REG	11/16/1999	BERYLLIUM		U	ug/L
99RC-GG03-WF-1-26.7	REG	11/2/1999	BERYLLIUM		U	ug/L
99RC-GG02-WF-1-26.7	REG	11/2/1999	BERYLLIUM		U	ug/L
00RC-GG09-WF-1-25	REG	1/25/2000	BERYLLIUM		U	ug/L
00RC-GG10-WF-1-29	REG	1/27/2000	BERYLLIUM		U	ug/L
00RC-GG11-WF-1-29	REG	1/27/2000	BERYLLIUM		U	ug/L
00RC-MW01-WF-1-27	REG	2/1/2000	BERYLLIUM		UJ	ug/L
00RC-MW02-WF-1-28	REG	2/1/2000	BERYLLIUM		U	ug/L
00RC-MW05-WF-1-22	REG	2/1/2000	BERYLLIUM		U	ug/L
00RC-MW06-WF-1-22	REG	2/1/2000	BERYLLIUM		U	ug/L
00RC-MW07-WF-1-23	REG	2/1/2000	BERYLLIUM		U	ug/L

SAMPLE ID NUMBER	TYPE	SAMPLE DATE	ANALYTE	RESULT	Qualifier	UNIT
99RC-GG03-WF-1-26.7	REG	11/2/1999	CADMIUM	0.8	U	ug/L
00RC-MW01-WF-1-27	REG	2/1/2000	CADMIUM	0.68	U	ug/L
00RC-MW07-WF-1-23	REG	2/1/2000	CADMIUM	0.35	J	ug/L
99RC-MW05-WF-1-22	REG	11/16/1999	CADMIUM		U	ug/L
99RC-MW04B-WF-1-30	REG	11/16/1999	CADMIUM		U	ug/L
99RC-MW03-WF-1-29	REG	11/16/1999	CADMIUM		U	ug/L
99RC-MW02-WF-1-28	REG	11/16/1999	CADMIUM		U	ug/L
99RC-MW01-WF-1-27	REG	11/16/1999	CADMIUM		U	ug/L
99RC-GG02-WF-1-26.7	REG	11/2/1999	CADMIUM		U	ug/L
99RC-GG01-WF-1-26.7	REG	11/3/1999	CADMIUM		U	ug/L
00RC-GG09-WF-1-25	REG	1/25/2000	CADMIUM		U	ug/L
00RC-GG10-WF-1-29	REG	1/27/2000	CADMIUM		U	ug/L
00RC-GG11-WF-1-29	REG	1/27/2000	CADMIUM		U	ug/L
00RC-MW02-WF-1-28	REG	2/1/2000	CADMIUM		U	ug/L
00RC-MW05-WF-1-22	REG	2/1/2000	CADMIUM		U	ug/L
00RC-MW06-WF-1-22	REG	2/1/2000	CADMIUM		U	ug/L

SAMPLE ID NUMBER	TYPE	SAMPLE DATE	ANALYTE	RESULT	Qualifier	UNIT
99RC-GG03-WF-1-26.7	REG	11/2/1999	CHROMIUM	4.3	J	ug/L
00RC-MW05-WF-1-22	REG	2/1/2000	CHROMIUM	4.3	J	ug/L
00RC-GG09-WF-1-25	REG	1/25/2000	CHROMIUM	3.4	U	ug/L
99RC-MW04B-WF-1-30	REG	11/16/1999	CHROMIUM	3.2	U	ug/L
99RC-GG01-WF-1-26.7	REG	11/3/1999	CHROMIUM	3.2	U	ug/L
00RC-MW01-WF-1-27	REG	2/1/2000	CHROMIUM	3.1	J	ug/L
99RC-MW02-WF-1-28	REG	11/16/1999	CHROMIUM	2.9	UJ	ug/L
99RC-GG02-WF-1-26.7	REG	11/2/1999	CHROMIUM	2.8	J	ug/L
99RC-MW05-WF-1-22	REG	11/16/1999	CHROMIUM	2.2	U	ug/L
00RC-GG11-WF-1-29	REG	1/27/2000	CHROMIUM	2	U	ug/L
00RC-MW07-WF-1-23	REG	2/1/2000	CHROMIUM	1.9	J	ug/L
00RC-GG10-WF-1-29	REG	1/27/2000	CHROMIUM	1.8	U	ug/L
00RC-MW06-WF-1-22	REG	2/1/2000	CHROMIUM	1.7	J	ug/L
99RC-MW03-WF-1-29	REG	11/16/1999	CHROMIUM	1.6	U	ug/L
00RC-MW02-WF-1-28	REG	2/1/2000	CHROMIUM	1.3		ug/L
99RC-MW01-WF-1-27	REG	11/16/1999	CHROMIUM	0.93	U	ug/L

SAMPLE ID NUMBER	TYPE	SAMPLE DATE	ANALYTE	RESULT	Qualifier	UNIT
99RC-GG03-WF-1-26 7	REG	11/2/1999	COBALT	16 5		ug/L
99RC-GG01-WF-1-26 7	REG	11/3/1999	COBALT	12 6		ug/L
99RC-GG02-WF-1-26 7	REG	11/2/1999	COBALT	7 9		ug/L
00RC-GG09-WF-1-25	REG	1/25/2000	COBALT	7 5		ug/L
00RC-GG10-WF-1-29	REG	1/27/2000	COBALT	6 7	U	ug/L
99RC-MW03-WF-1-29	REG	11/16/1999	COBALT	3 5	U	ug/L
00RC-GG11-WF-1-29	REG	1/27/2000	COBALT	3 2	U	ug/L
99RC-MW02-WF-1-28	REG	11/16/1999	COBALT	2 1	UJ	ug/L
99RC-MW05-WF-1-22	REG	11/16/1999	COBALT	2	U	ug/L
00RC-MW06-WF-1-22	REG	2/1/2000	COBALT	1 9	J	ug/L
00RC-MW05-WF-1-22	REG	2/1/2000	COBALT	1 3	U	ug/L
00RC-MW01-WF-1-27	REG	2/1/2000	COBALT	1	UJ	ug/L
99RC-MW04B-WF-1-30	REG	11/16/1999	COBALT	0 9	U	ug/L
00RC-MW02-WF-1-28	REG	2/1/2000	COBALT	0 9	J	ug/L
99RC-MW01-WF-1-27	REG	11/16/1999	COBALT	0 78	U	ug/L
00RC-MW07-WF-1-23	REG	2/1/2000	COBALT		U	ug/L

SAMPLE ID NUMBER	TYPE	SAMPLE DATE	ANALYTE	RESULT	Qualifier	UNIT
00RC-MW07-WF-1-23	REG	2/1/2000	COPPER	12.1		ug/L
99RC-MW02-WF-1-28	REG	11/16/1999	COPPER	10.9	J	ug/L
00RC-GG09-WF-1-25	REG	1/25/2000	COPPER	9.8	J	ug/L
00RC-MW05-WF-1-22	REG	2/1/2000	COPPER	9.1	J	ug/L
99RC-MW05-WF-1-22	REG	11/16/1999	COPPER	8.4	J	ug/L
99RC-GG01-WF-1-26.7	REG	11/3/1999	COPPER	7.6	J	ug/L
00RC-MW06-WF-1-22	REG	2/1/2000	COPPER	6.8	J	ug/L
99RC-GG03-WF-1-26.7	REG	11/2/1999	COPPER	6.6	J	ug/L
99RC-MW01-WF-1-27	REG	11/16/1999	COPPER	6.5	J	ug/L
99RC-GG02-WF-1-26.7	REG	11/2/1999	COPPER	6.4	J	ug/L
00RC-GG11-WF-1-29	REG	1/27/2000	COPPER	6.4	U	ug/L
00RC-MW02-WF-1-28	REG	2/1/2000	COPPER	6.3		ug/L
99RC-MW04B-WF-1-30	REG	11/16/1999	COPPER	5.8	J	ug/L
00RC-MW01-WF-1-27	REG	2/1/2000	COPPER	5.7	J	ug/L
00RC-GG10-WF-1-29	REG	1/27/2000	COPPER	5.3	U	ug/L
99RC-MW03-WF-1-29	REG	11/16/1999	COPPER	1.1	U	ug/L

SAMPLE ID NUMBER	TYPE	SAMPLE DATE	ANALYTE	RESULT	Qualifier	UNIT
99RC-GG02-WF-1-26.7	REG	11/2/1999	IRON	784		ug/L
00RC-MW07-WF-1-23	REG	2/1/2000	IRON	207	J	ug/L
00RC-GG11-WF-1-29	REG	1/27/2000	IRON	169	J	ug/L
99RC-GG03-WF-1-26.7	REG	11/2/1999	IRON	163		ug/L
00RC-GG10-WF-1-29	REG	1/27/2000	IRON	144	J	ug/L
99RC-GG01-WF-1-26.7	REG	11/3/1999	IRON	38	1 J	ug/L
00RC-MW02-WF-1-28	REG	2/1/2000	IRON	32	1 J	ug/L
00RC-GG09-WF-1-25	REG	1/25/2000	IRON	23.2	J	ug/L
99RC-MW03-WF-1-29	REG	11/16/1999	IRON	15.7	U	ug/L
00RC-MW01-WF-1-27	REG	2/1/2000	IRON	11	J	ug/L
99RC-MW02-WF-1-28	REG	11/16/1999	IRON	10	9 UJ	ug/L
99RC-MW01-WF-1-27	REG	11/16/1999	IRON	9	9 U	ug/L
99RC-MW04B-WF-1-30	REG	11/16/1999	IRON	5.2	U	ug/L
99RC-MW05-WF-1-22	REG	11/16/1999	IRON		U	ug/L
00RC-MW05-WF-1-22	REG	2/1/2000	IRON		U	ug/L
00RC-MW06-WF-1-22	REG	2/1/2000	IRON		UJ	ug/L

SAMPLE ID NUMBER	TYPE	SAMPLE DATE	ANALYTE	RESULT	Qualifier	UNIT
99RC-GG01-WF-1-26 7	REG	11/3/1999	LEAD	16.8		ug/L
00RC-MW07-WF-1-23	REG	2/1/2000	LEAD	6.9		ug/L
99RC-GG03-WF-1-26 7	REG	11/2/1999	LEAD	5.2	UJ	ug/L
00RC-MW01-WF-1-27	REG	2/1/2000	LEAD	3.6	UJ	ug/L
00RC-MW05-WF-1-22	REG	2/1/2000	LEAD	3.1	U	ug/L
00RC-GG09-WF-1-25	REG	1/25/2000	LEAD	2.9	U	ug/L
99RC-GG02-WF-1-26 7	REG	11/2/1999	LEAD	2.6	UJ	ug/L
00RC-MW02-WF-1-28	REG	2/1/2000	LEAD	2.5	U	ug/L
99RC-MW01-WF-1-27	REG	11/16/1999	LEAD	1.2	U	ug/L
99RC-MW05-WF-1-22	REG	11/16/1999	LEAD		U	ug/L
99RC-MW04B-WF-1-30	REG	11/16/1999	LEAD		U	ug/L
99RC-MW03-WF-1-29	REG	11/16/1999	LEAD		U	ug/L
99RC-MW02-WF-1-28	REG	11/16/1999	LEAD		U	ug/L
00RC-GG10-WF-1-29	REG	1/27/2000	LEAD		U	ug/L
00RC-GG11-WF-1-29	REG	1/27/2000	LEAD		U	ug/L
00RC-MW06-WF-1-22	REG	2/1/2000	LEAD		U	ug/L

SAMPLE ID NUMBER	TYPE	SAMPLE DATE	ANALYTE	RESULT	Qualifier	UNIT
00RC-MW05-WF-1-22	REG	2/1/2000	MERCURY	0.56		ug/L
99RC-GG01-WF-1-26.7	REG	11/3/1999	MERCURY	0.48	J	ug/L
00RC-MW02-WF-1-28	REG	2/1/2000	MERCURY	0.47	J	ug/L
99RC-MW05-WF-1-22	REG	11/16/1999	MERCURY	0.38	J	ug/L
00RC-MW06-WF-1-22	REG	2/1/2000	MERCURY	0.38	J	ug/L
00RC-MW01-WF-1-27	REG	2/1/2000	MERCURY	0.36	J	ug/L
00RC-MW07-WF-1-23	REG	2/1/2000	MERCURY	0.29	J	ug/L
00RC-GG09-WF-1-25	REG	1/25/2000	MERCURY	0.28	J	ug/L
99RC-MW03-WF-1-29	REG	11/16/1999	MERCURY	0.22	J	ug/L
99RC-MW01-WF-1-27	REG	11/16/1999	MERCURY	0.21	J	ug/L
99RC-MW04B-WF-1-30	REG	11/16/1999	MERCURY	0.2	J	ug/L
99RC-MW02-WF-1-28	REG	11/16/1999	MERCURY	0.16	J	ug/L
99RC-GG03-WF-1-26.7	REG	11/2/1999	MERCURY		U	ug/L
99RC-GG02-WF-1-26.7	REG	11/2/1999	MERCURY		U	ug/L
00RC-GG10-WF-1-29	REG	1/27/2000	MERCURY		U	ug/L
00RC-GG11-WF-1-29	REG	1/27/2000	MERCURY		U	ug/L

SAMPLE ID NUMBER	TYPE	SAMPLE DATE	ANALYTE	RESULT	Qualifier	UNIT
00RC-MW06-WF-1-22	REG	2/1/2000	MOLYBDENUM	344		ug/L
00RC-MW01-WF-1-27	REG	2/1/2000	MOLYBDENUM	66.4	J	ug/L
99RC-MW03-WF-1-29	REG	11/16/1999	MOLYBDENUM	63.5		ug/L
99RC-GG01-WF-1-26.7	REG	11/3/1999	MOLYBDENUM	60.7		ug/L
99RC-MW01-WF-1-27	REG	11/16/1999	MOLYBDENUM	52.7		ug/L
00RC-GG11-WF-1-29	REG	1/27/2000	MOLYBDENUM	48.3		ug/L
00RC-GG10-WF-1-29	REG	1/27/2000	MOLYBDENUM	46.7		ug/L
99RC-GG03-WF-1-26.7	REG	11/2/1999	MOLYBDENUM	41		ug/L
99RC-MW04B-WF-1-30	REG	11/16/1999	MOLYBDENUM	37.1		ug/L
99RC-MW02-WF-1-28	REG	11/16/1999	MOLYBDENUM	36.3		ug/L
00RC-MW02-WF-1-28	REG	2/1/2000	MOLYBDENUM	35.4		ug/L
99RC-GG02-WF-1-26.7	REG	11/2/1999	MOLYBDENUM	30.6		ug/L
00RC-GG09-WF-1-25	REG	1/25/2000	MOLYBDENUM	24		ug/L
99RC-MW05-WF-1-22	REG	11/16/1999	MOLYBDENUM	19.6		ug/L
00RC-MW07-WF-1-23	REG	2/1/2000	MOLYBDENUM	17.3		ug/L
00RC-MW05-WF-1-22	REG	2/1/2000	MOLYBDENUM	15.9	U	ug/L

SAMPLE ID NUMBER	TYPE	SAMPLE DATE	ANALYTE	RESULT	Qualifier	UNIT
99RC-GG03-WF-1-26 7	REG	11/2/1999	NICKEL	41.2		ug/L
99RC-GG01-WF-1-26 7	REG	11/3/1999	NICKEL	26.8		ug/L
99RC-GG02-WF-1-26 7	REG	11/2/1999	NICKEL	14.7		ug/L
00RC-MW01-WF-1-27	REG	2/1/2000	NICKEL	9.7		ug/L
00RC-MW07-WF-1-23	REG	2/1/2000	NICKEL	9.6		ug/L
00RC-GG10-WF-1-29	REG	1/27/2000	NICKEL	8.3	U	ug/L
99RC-MW02-WF-1-28	REG	11/16/1999	NICKEL	8.1		ug/L
00RC-GG09-WF-1-25	REG	1/25/2000	NICKEL	7.8		ug/L
00RC-MW02-WF-1-28	REG	2/1/2000	NICKEL	7.6		ug/L
99RC-MW01-WF-1-27	REG	11/16/1999	NICKEL	6.1		ug/L
00RC-GG11-WF-1-29	REG	1/27/2000	NICKEL	6.1	U	ug/L
00RC-MW05-WF-1-22	REG	2/1/2000	NICKEL	5.9	U	ug/L
99RC-MW05-WF-1-22	REG	11/16/1999	NICKEL	5.7	U	ug/L
99RC-MW03-WF-1-29	REG	11/16/1999	NICKEL	5.4	U	ug/L
00RC-MW06-WF-1-22	REG	2/1/2000	NICKEL	3.4	J	ug/L
99RC-MW04B-WF-1-30	REG	11/16/1999	NICKEL	0.55	U	ug/L

SAMPLE ID NUMBER	TYPE	SAMPLE DATE	ANALYTE	RESULT	Qualifier	UNIT
99RC-GG02-WF-1-26.7	REG	11/2/1999	SELENIUM	22.6		ug/L
99RC-MW05-WF-1-22	REG	11/16/1999	SELENIUM	21.8	U	ug/L
99RC-MW02-WF-1-28	REG	11/16/1999	SELENIUM	21	U	ug/L
00RC-MW07-WF-1-23	REG	2/1/2000	SELENIUM	18.4	J	ug/L
99RC-GG03-WF-1-26.7	REG	11/2/1999	SELENIUM	18.3		ug/L
00RC-GG09-WF-1-25	REG	1/25/2000	SELENIUM	16.6		ug/L
99RC-MW01-WF-1-27	REG	11/16/1999	SELENIUM	14.6	U	ug/L
00RC-GG10-WF-1-29	REG	1/27/2000	SELENIUM	14.2	U	ug/L
99RC-GG01-WF-1-26.7	REG	11/3/1999	SELENIUM	13.6		ug/L
00RC-GG11-WF-1-29	REG	1/27/2000	SELENIUM	13.2	U	ug/L
00RC-MW01-WF-1-27	REG	2/1/2000	SELENIUM	12.1	U	ug/L
00RC-MW05-WF-1-22	REG	2/1/2000	SELENIUM	10	U	ug/L
99RC-MW04B-WF-1-30	REG	11/16/1999	SELENIUM	6.2	U	ug/L
99RC-MW03-WF-1-29	REG	11/16/1999	SELENIUM	4	U	ug/L
00RC-MW02-WF-1-28	REG	2/1/2000	SELENIUM		UJ	ug/L
00RC-MW06-WF-1-22	REG	2/1/2000	SELENIUM		UJ	ug/L

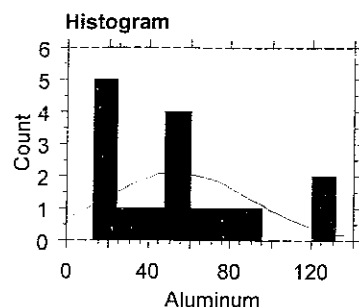
SAMPLE ID NUMBER	TYPE	SAMPLE DATE	ANALYTE	RESULT	Qualifier	UNIT
00RC-GG09-WF-1-25	REG	1/25/2000	SILVER	3.8	U	ug/L
00RC-MW02-WF-1-28	REG	2/1/2000	SILVER	3.4		ug/L
00RC-MW01-WF-1-27	REG	2/1/2000	SILVER	2.1	UJ	ug/L
99RC-MW05-WF-1-22	REG	11/16/1999	SILVER		U	ug/L
99RC-MW04B-WF-1-30	REG	11/16/1999	SILVER		U	ug/L
99RC-MW03-WF-1-29	REG	11/16/1999	SILVER		U	ug/L
99RC-MW02-WF-1-28	REG	11/16/1999	SILVER		U	ug/L
99RC-MW01-WF-1-27	REG	11/16/1999	SILVER		U	ug/L
99RC-GG03-WF-1-26 7	REG	11/2/1999	SILVER		U	ug/L
99RC-GG02-WF-1-26 7	REG	11/2/1999	SILVER		U	ug/L
99RC-GG01-WF-1-26 7	REG	11/3/1999	SILVER		U	ug/L
00RC-GG10-WF-1-29	REG	1/27/2000	SILVER		U	ug/L
00RC-GG11-WF-1-29	REG	1/27/2000	SILVER		U	ug/L
00RC-MW05-WF-1-22	REG	2/1/2000	SILVER		U	ug/L
00RC-MW06-WF-1-22	REG	2/1/2000	SILVER		U	ug/L
00RC-MW07-WF-1-23	REG	2/1/2000	SILVER		U	ug/L

SAMPLE ID NUMBER	TYPE	SAMPLE DATE	ANALYTE	RESULT	Qualifier	UNIT
99RC-MW04B-WF-1-30	REG	11/16/1999	THALLIUM	4.2	U	ug/L
99RC-MW02-WF-1-28	REG	11/16/1999	THALLIUM	3.6	UJ	ug/L
99RC-MW05-WF-1-22	REG	11/16/1999	THALLIUM	3.5	U	ug/L
99RC-MW03-WF-1-29	REG	11/16/1999	THALLIUM	2.6	U	ug/L
99RC-GG01-WF-1-26.7	REG	11/3/1999	THALLIUM	1.8	U	ug/L
99RC-MW01-WF-1-27	REG	11/16/1999	THALLIUM		U	ug/L
99RC-GG03-WF-1-26.7	REG	11/2/1999	THALLIUM		U	ug/L
99RC-GG02-WF-1-26.7	REG	11/2/1999	THALLIUM		U	ug/L
00RC-GG09-WF-1-25	REG	1/25/2000	THALLIUM		U	ug/L
00RC-GG10-WF-1-29	REG	1/27/2000	THALLIUM		U	ug/L
00RC-GG11-WF-1-29	REG	1/27/2000	THALLIUM		U	ug/L
00RC-MW01-WF-1-27	REG	2/1/2000	THALLIUM		U	ug/L
00RC-MW02-WF-1-28	REG	2/1/2000	THALLIUM		U	ug/L
00RC-MW05-WF-1-22	REG	2/1/2000	THALLIUM		U	ug/L
00RC-MW06-WF-1-22	REG	2/1/2000	THALLIUM		U	ug/L
00RC-MW07-WF-1-23	REG	2/1/2000	THALLIUM		U	ug/L

SAMPLE ID NUMBER	TYPE	SAMPLE DATE	ANALYTE	RESULT	Qualifier	UNIT
99RC-MW04B-WF-1-30	REG	11/16/1999	VANADIUM	10.1	U	ug/L
99RC-MW01-WF-1-27	REG	11/16/1999	VANADIUM	6.2	U	ug/L
99RC-MW02-WF-1-28	REG	11/16/1999	VANADIUM	6.1	U	ug/L
00RC-GG10-WF-1-29	REG	1/27/2000	VANADIUM	4.8	U	ug/L
00RC-GG11-WF-1-29	REG	1/27/2000	VANADIUM	4.7	U	ug/L
00RC-MW07-WF-1-23	REG	2/1/2000	VANADIUM	4.4	J	ug/L
00RC-MW02-WF-1-28	REG	2/1/2000	VANADIUM	3.7		ug/L
00RC-MW01-WF-1-27	REG	2/1/2000	VANADIUM	3.6	UJ	ug/L
00RC-MW05-WF-1-22	REG	2/1/2000	VANADIUM	3.3	U	ug/L
99RC-MW05-WF-1-22	REG	11/16/1999	VANADIUM	2.7	U	ug/L
00RC-GG09-WF-1-25	REG	1/25/2000	VANADIUM	2.5	U	ug/L
99RC-GG02-WF-1-26.7	REG	11/2/1999	VANADIUM	1.4	U	ug/L
99RC-GG01-WF-1-26.7	REG	11/3/1999	VANADIUM	1.4	U	ug/L
99RC-MW03-WF-1-29	REG	11/16/1999	VANADIUM	1	U	ug/L
99RC-GG03-WF-1-26.7	REG	11/2/1999	VANADIUM		U	ug/L
00RC-MW06-WF-1-22	REG	2/1/2000	VANADIUM		U	ug/L

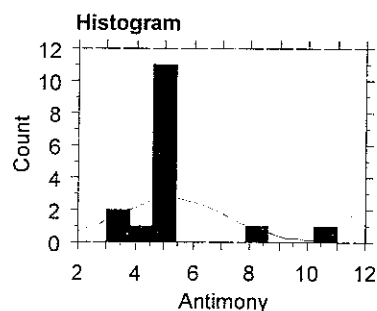
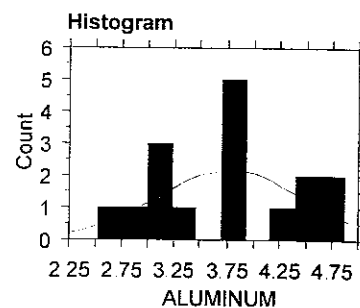
SAMPLE ID NUMBER	TYPE	SAMPLE DATE	ANALYTE	RESULT	Qualifier	UNIT
99RC-GG01-WF-1-26 7	REG	11/3/1999	ZINC	24.9		ug/L
00RC-MW01-WF-1-27	REG	2/1/2000	ZINC	23.6	J	ug/L
99RC-MW02-WF-1-28	REG	11/16/1999	ZINC	22.3	J	ug/L
99RC-MW05-WF-1-22	REG	11/16/1999	ZINC	17.4	J	ug/L
00RC-GG10-WF-1-29	REG	1/27/2000	ZINC	17.4		ug/L
99RC-MW01-WF-1-27	REG	11/16/1999	ZINC	14.6	J	ug/L
00RC-GG11-WF-1-29	REG	1/27/2000	ZINC	13.8	U	ug/L
99RC-MW04B-WF-1-30	REG	11/16/1999	ZINC	12.8	J	ug/L
99RC-GG03-WF-1-26 7	REG	11/2/1999	ZINC	12.1	J	ug/L
00RC-MW07-WF-1-23	REG	2/1/2000	ZINC	11.1		ug/L
00RC-MW02-WF-1-28	REG	2/1/2000	ZINC	10		ug/L
99RC-MW03-WF-1-29	REG	11/16/1999	ZINC	9.6	J	ug/L
00RC-MW06-WF-1-22	REG	2/1/2000	ZINC	9.6		ug/L
99RC-GG02-WF-1-26 7	REG	11/2/1999	ZINC	9.1	J	ug/L
00RC-MW05-WF-1-22	REG	2/1/2000	ZINC	7.8		ug/L
00RC-GG09-WF-1-25	REG	1/25/2000	ZINC	7.2		ug/L

Groundwater Histograms and Summary Statistics, Natural Log Histogram



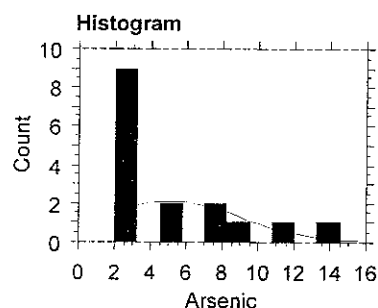
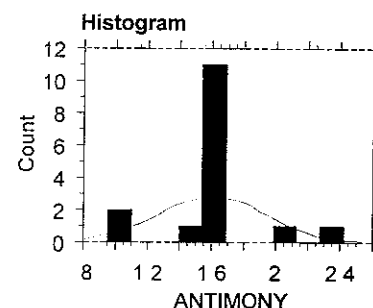
Descriptive Statistics

Aluminum	
Mean	54.063
Std Dev	36.096
Std Error	9.024
Count	16
Minimum	12.400
Maximum	131.000
# Missing	0



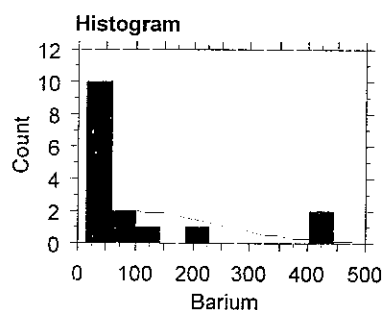
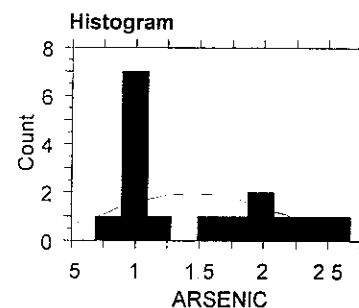
Descriptive Statistics

Antimony	
Mean	5.250
Std Dev	1.880
Std Error	.470
Count	16
Minimum	3.000
Maximum	11.000
# Missing	0



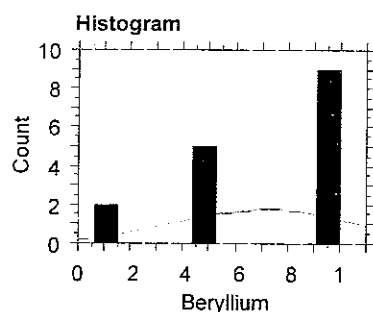
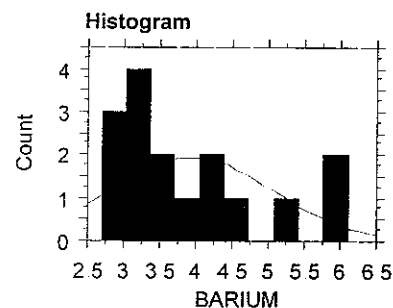
Descriptive Statistics

Arsenic	
Mean	5.256
Std Dev	3.770
Std Error	.942
Count	16
Minimum	2.000
Maximum	14.500
# Missing	0



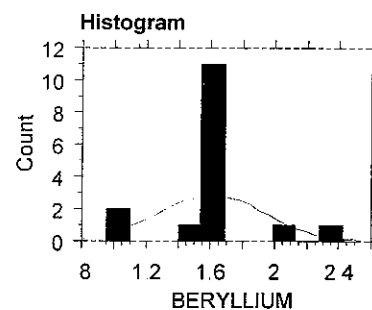
Descriptive Statistics

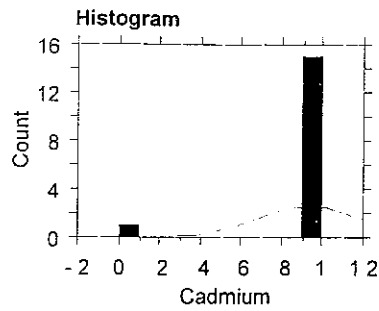
Barium	
Mean	101.481
Std Dev	141.666
Std Error	35.417
Count	16
Minimum	14.600
Maximum	445.000
# Missing	0



Descriptive Statistics

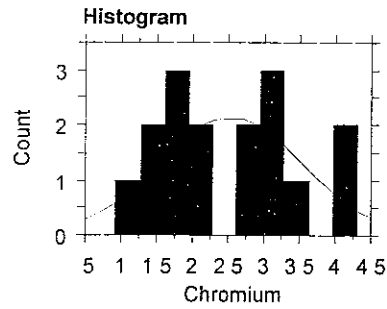
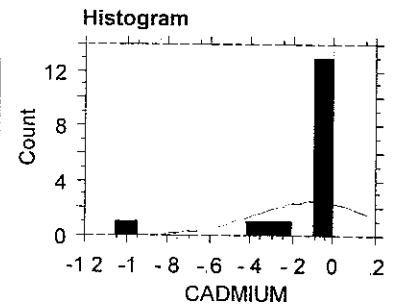
Beryllium	
Mean	.727
Std Dev	.346
Std Error	.086
Count	16
Minimum	.060
Maximum	1.000
# Missing	0





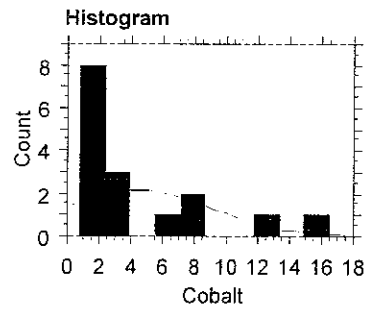
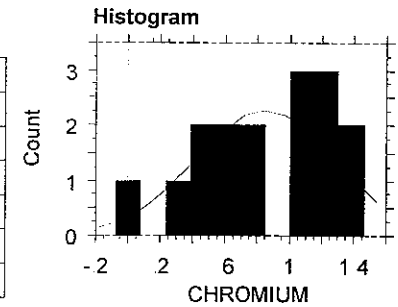
Descriptive Statistics

	Cadmium
Mean	.938
Std Dev	250
Std Error	.063
Count	16
Minimum	0.000
Maximum	1.000
# Missing	0



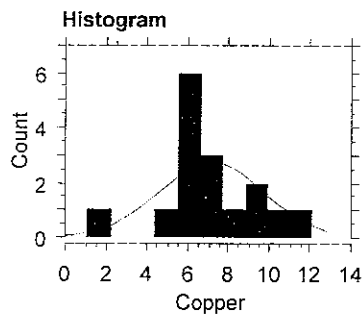
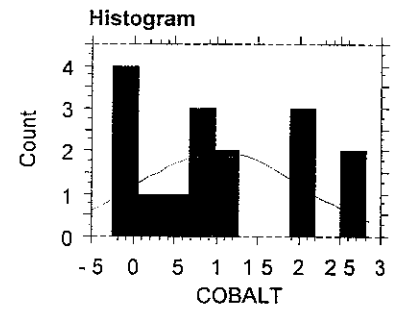
Descriptive Statistics

	Chromium
Mean	2.539
Std Dev	1.013
Std Error	.253
Count	16
Minimum	.930
Maximum	4.300
# Missing	0



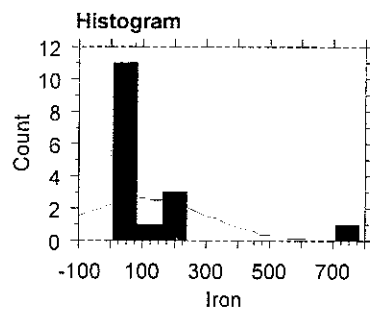
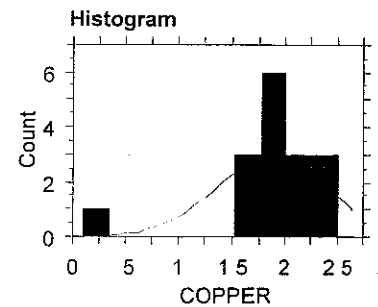
Descriptive Statistics

	Cobalt
Mean	4.455
Std Dev	4.638
Std Error	1.160
Count	16
Minimum	.780
Maximum	16.500
# Missing	0



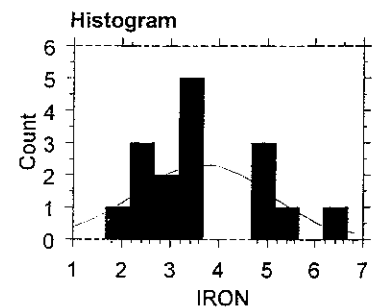
Descriptive Statistics

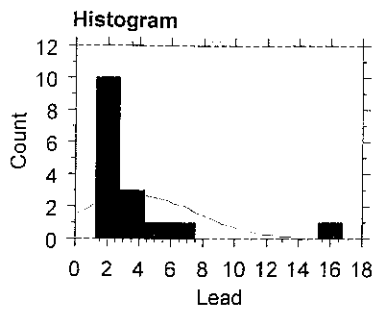
	Copper
Mean	7.175
Std Dev	2.553
Std Error	.638
Count	16
Minimum	1.100
Maximum	12.100
# Missing	0



Descriptive Statistics

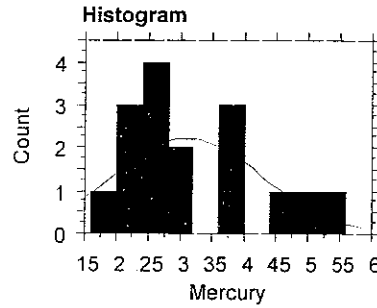
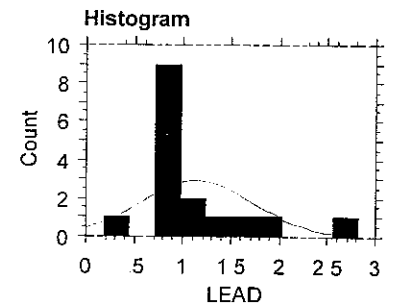
	Iron
Mean	105.506
Std Dev	193.352
Std Error	48.338
Count	16
Minimum	5.200
Maximum	784.000
# Missing	0





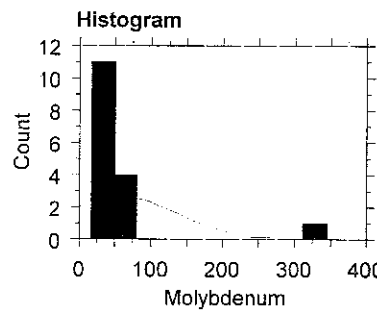
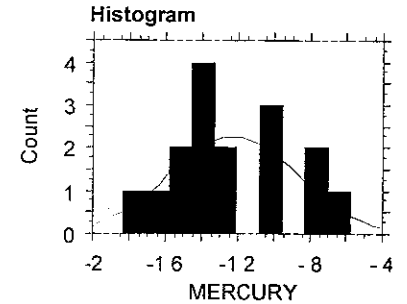
Descriptive Statistics

Lead	
Mean	3.894
Std Dev	3.683
Std Error	.921
Count	16
Minimum	1.200
Maximum	16.800
# Missing	0



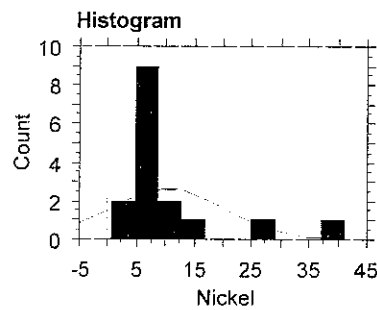
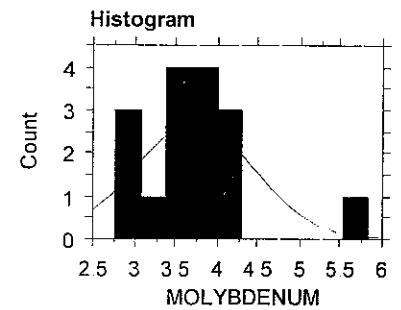
Descriptive Statistics

Mercury	
Mean	.312
Std Dev	.115
Std Error	.029
Count	16
Minimum	160
Maximum	560
# Missing	0



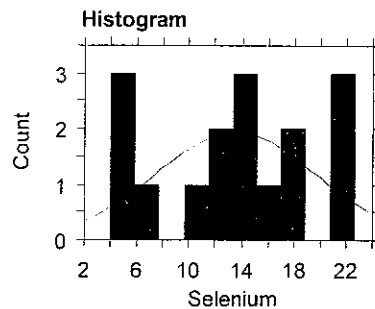
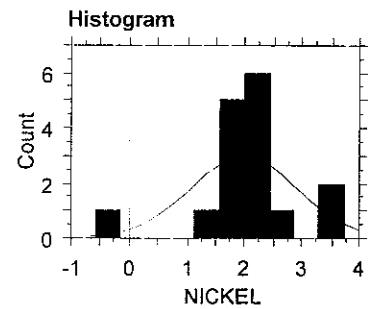
Descriptive Statistics

Molyb	
Mean	58.719
Std Dev	77.745
Std Error	19.436
Count	16
Minimum	15.900
Maximum	344.000
# Missing	0



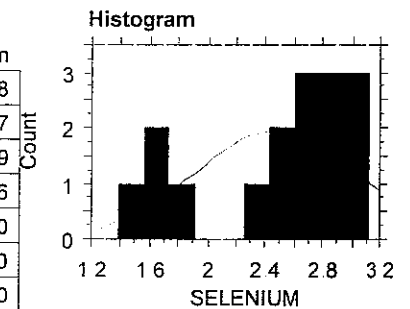
Descriptive Statistics

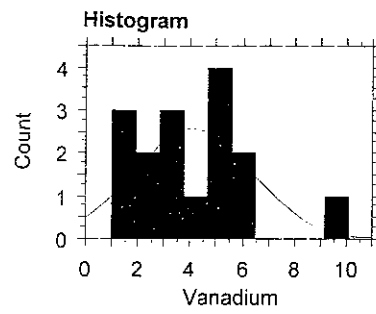
Nickel	
Mean	10.434
Std Dev	10.039
Std Error	2.510
Count	16
Minimum	550
Maximum	41.200
# Missing	0



Descriptive Statistics

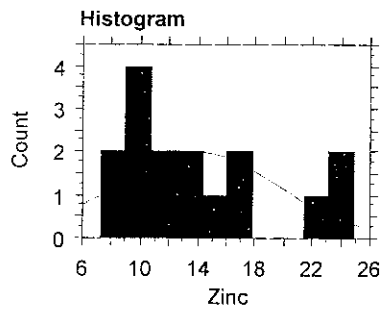
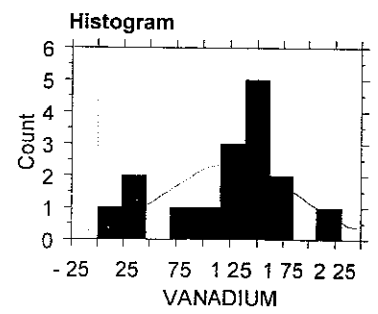
Selenium	
Mean	13.538
Std Dev	6.157
Std Error	1.539
Count	16
Minimum	4.000
Maximum	22.600
# Missing	0





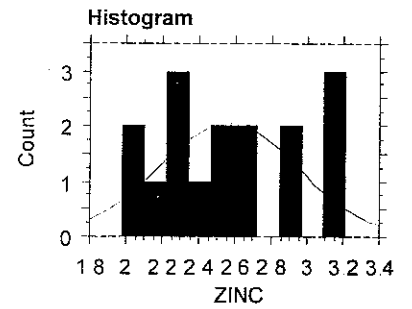
Descriptive Statistics

Vanadium	
Mean	4.119
Std. Dev.	2.262
Std. Error	.565
Count	16
Minimum	1.000
Maximum	10.100
# Missing	0



Descriptive Statistics

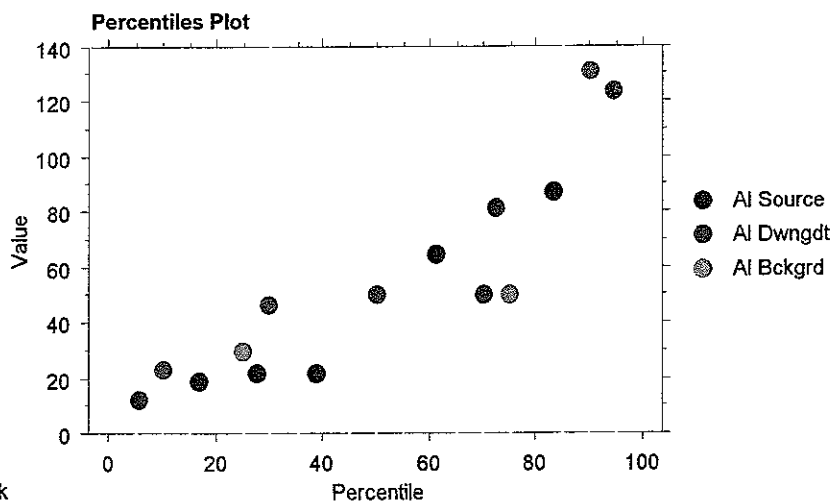
Zinc	
Mean	13.956
Std. Dev.	5.658
Std. Error	1.415
Count	16
Minimum	7.200
Maximum	24.900
# Missing	0



Kruskal-Wallis Statistical Test Results

Kruskal-Wallis Test for Aluminum
Grouping Variable: Areas

DF	2
# Groups	3
# Ties	1
H	.272
P-Value	.8727
H corrected for ties	.276
Tied P-Value	.8709

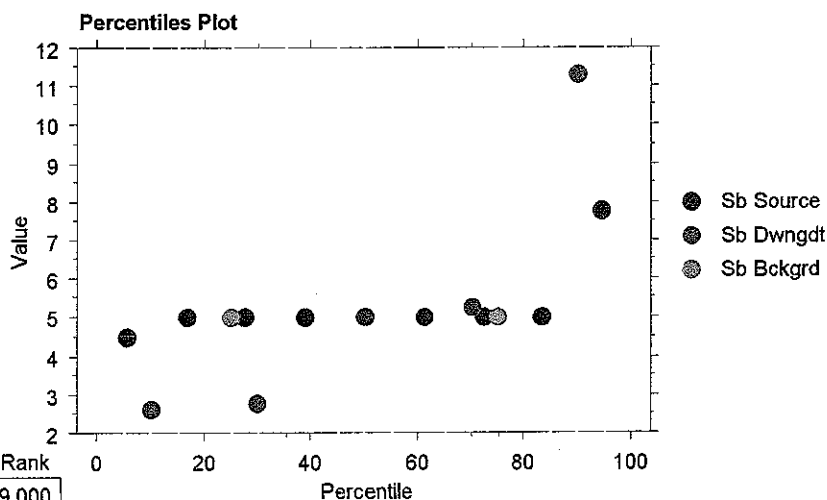


Kruskal-Wallis Rank Info for Aluminum
Grouping Variable: Areas

	Count	Sum Ranks	Mean Rank
Bckgrd	2	15.500	7.750
Dwngdt	5	47.000	9.400
Source	9	73.500	8.167

Kruskal-Wallis Test for Antimony
Grouping Variable: Areas

DF	2
# Groups	3
# Ties	2
H	.388
P-Value	.8236
H corrected for ties	.575
Tied P-Value	.7501

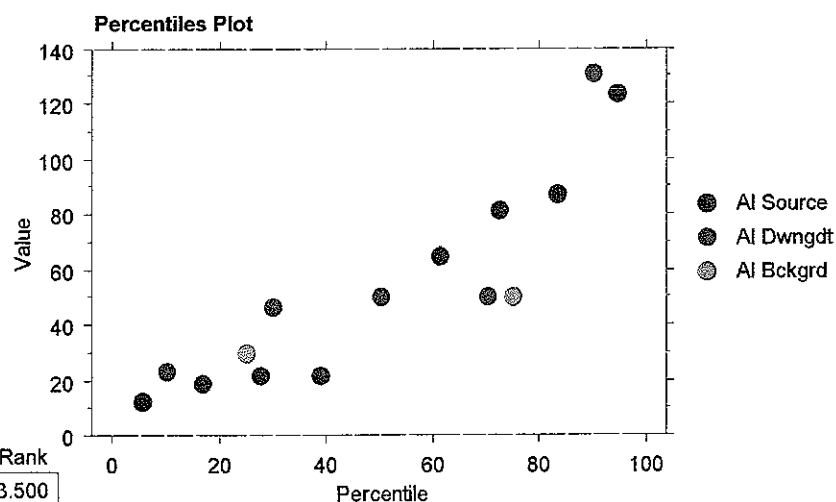


Kruskal-Wallis Rank Info for Antimony
Grouping Variable: Areas

	Count	Sum Ranks	Mean Rank
Bckgrd	2	18.000	9.000
Dwngdt	5	37.000	7.400
Source	9	81.000	9.000

Kruskal-Wallis Test for Arsenic
Grouping Variable: Areas

DF	2
# Groups	3
# Ties	1
H	2.749
P-Value	.2530
H corrected for ties	2.790
Tied P-Value	.2479



Kruskal-Wallis Rank Info for Arsenic
Grouping Variable: Areas

	Count	Sum Ranks	Mean Rank
Bckgrd	2	27.000	13.500
Dwngdt	5	43.000	8.600
Source	9	66.000	7.333

Kruskal-Wallis Test for Barium

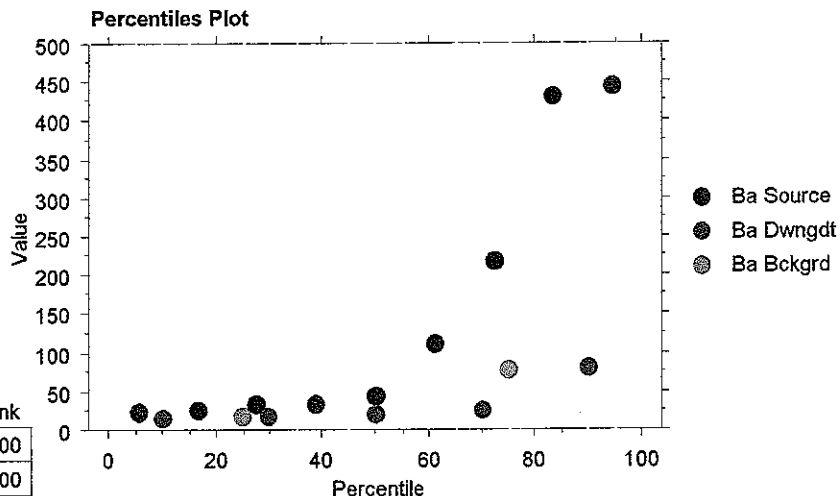
Grouping Variable: Areas

DF	2
# Groups	3
# Ties	0
H	4.815
P-Value	.0900
H corrected for ties	4.815
Tied P-Value	.0900

Kruskal-Wallis Rank Info for Barium

Grouping Variable: Areas

	Count	Sum Ranks	Mean Rank
Bckgrd	2	13.000	6.500
Dwngdt	5	26.000	5.200
Source	9	97.000	10.778



Kruskal-Wallis Test for Beryllium

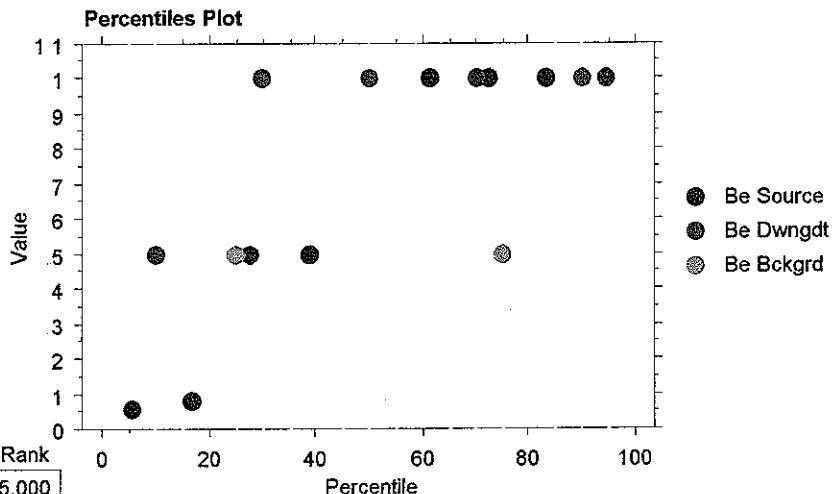
Grouping Variable: Areas

DF	2
# Groups	3
# Ties	2
H	2.114
P-Value	.3475
H corrected for ties	2.662
Tied P-Value	.2642

Kruskal-Wallis Rank Info for Beryllium

Grouping Variable: Areas

	Count	Sum Ranks	Mean Rank
Bckgrd	2	10.000	5.000
Dwngdt	5	53.000	10.600
Source	9	73.000	8.111



Kruskal-Wallis Test for Cobalt

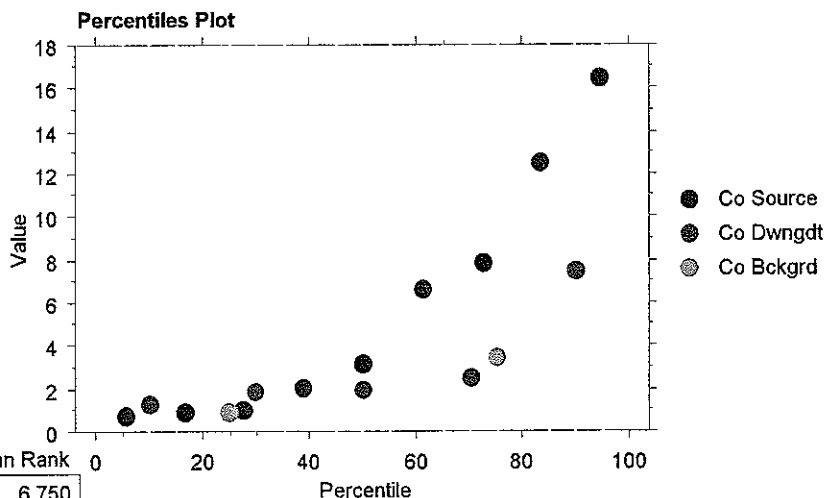
Grouping Variable: Areas

DF	2
# Groups	3
# Ties	1
H	.502
P-Value	.7781
H corrected for ties	.503
Tied P-Value	.7778

Kruskal-Wallis Rank Info for Cobalt

Grouping Variable: Areas

	Count	Sum Ranks	Mean Rank
Bckgrd	2	13.500	6.750
Dwngdt	5	40.000	8.000
Source	9	82.500	9.167

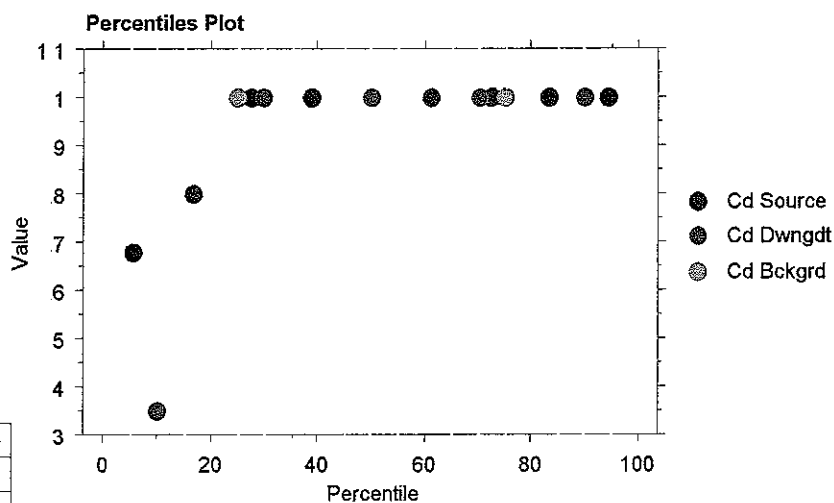


Kruskal-Wallis Test for Cadmium
Grouping Variable: Areas

DF	2
# Groups	3
# Ties	1
H	.388
P-Value	.8236
H corrected for ties	2.200
Tied P-Value	.3329

Kruskal-Wallis Rank Info for Cadmium
Grouping Variable: Areas

	Count	Sum Ranks	Mean Rank
Bckgrd	2	18.000	9.000
Dwngdt	5	37.000	7.400
Source	9	81.000	9.000

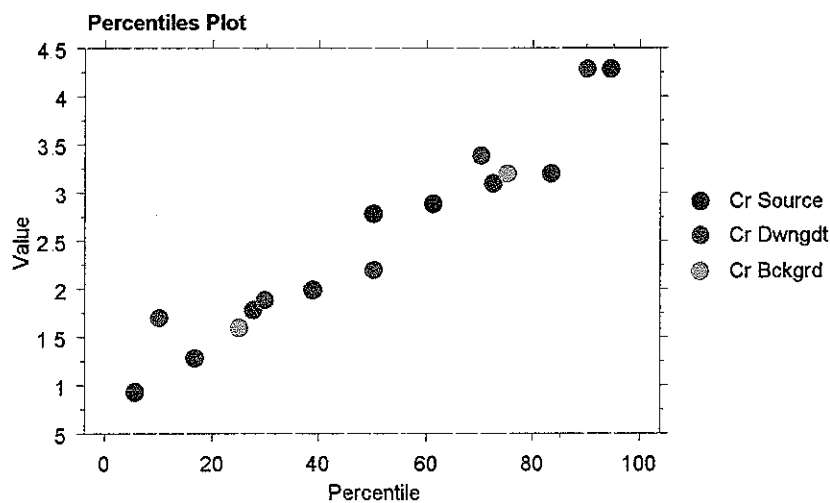


Kruskal-Wallis Test for Chromium
Grouping Variable: Areas

DF	2
# Groups	3
# Ties	2
H	.330
P-Value	.8478
H corrected for ties	.331
Tied P-Value	.8474

Kruskal-Wallis Rank Info for Chromium
Grouping Variable: Areas

	Count	Sum Ranks	Mean Rank
Bckgrd	2	15.500	7.750
Dwngdt	5	47.500	9.500
Source	9	73.000	8.111

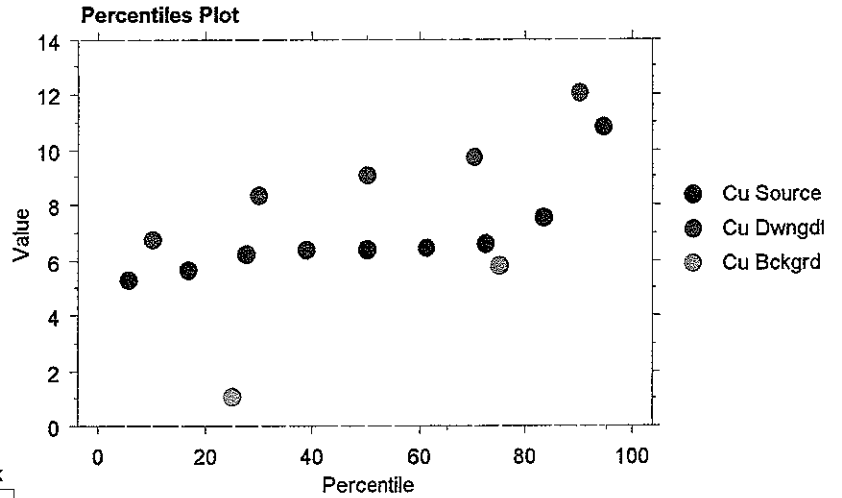


Kruskal-Wallis Test for Copper
Grouping Variable: Areas

DF	2
# Groups	3
# Ties	1
H	8.184
P-Value	.0167
H corrected for ties	8.196
Tied P-Value	.0166

Kruskal-Wallis Rank Info for Copper
Grouping Variable: Areas

	Count	Sum Ranks	Mean Rank
Bckgrd	2	5.000	2.500
Dwngdt	5	65.000	13.000
Source	9	66.000	7.333

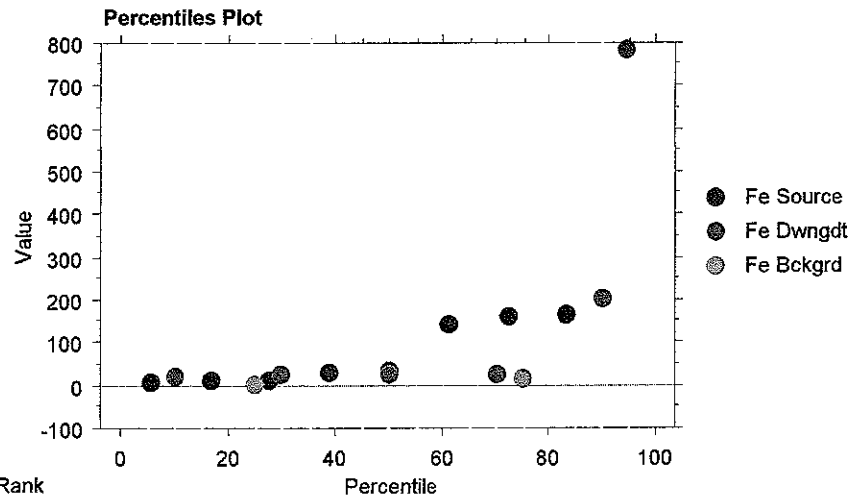


Kruskal-Wallis Test for Iron
Grouping Variable: Areas

DF	2
# Groups	3
# Ties	1
H	3.078
P-Value	.2145
H corrected for ties	3.097
Tied P-Value	.2126

Kruskal-Wallis Rank Info for Iron
Grouping Variable: Areas

	Count	Sum Ranks	Mean Rank
Bckgrd	2	6.000	3.000
Dwngdt	5	45.000	9.000
Source	9	85.000	9.444

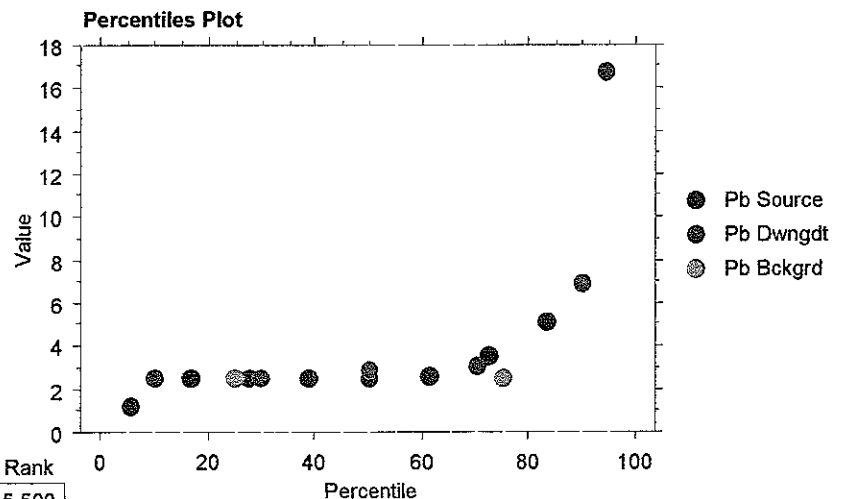


Kruskal-Wallis Test for Lead
Grouping Variable: Areas

DF	2
# Groups	3
# Ties	1
H	1.168
P-Value	.5576
H corrected for ties	1.333
Tied P-Value	.5136

Kruskal-Wallis Rank Info for Lead
Grouping Variable: Areas

	Count	Sum Ranks	Mean Rank
Bckgrd	2	11.000	5.500
Dwngdt	5	49.000	9.800
Source	9	76.000	8.444

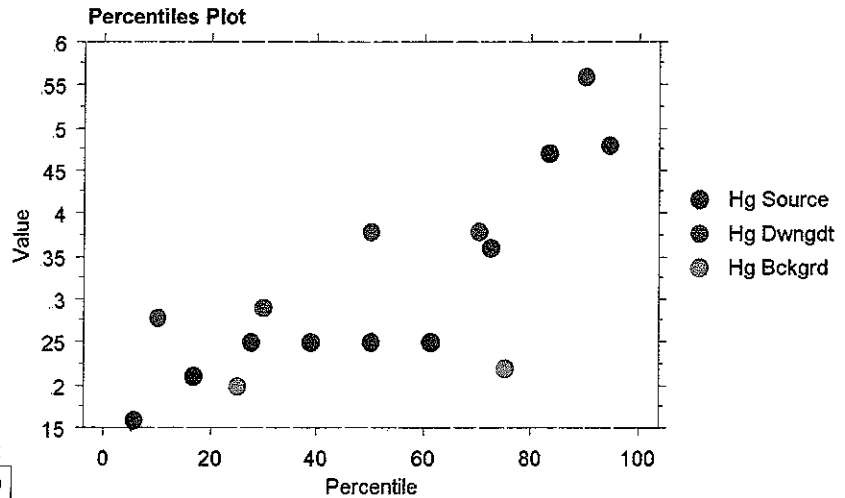


Kruskal-Wallis Test for Mercury
Grouping Variable: Areas

DF	2
# Groups	3
# Ties	2
H	5.578
P-Value	.0615
H corrected for ties	5.670
Tied P-Value	.0587

Kruskal-Wallis Rank Info for Mercury
Grouping Variable: Areas

	Count	Sum Ranks	Mean Rank
Bckgrd	2	6.000	3.000
Dwngdt	5	60.000	12.000
Source	9	70.000	7.778

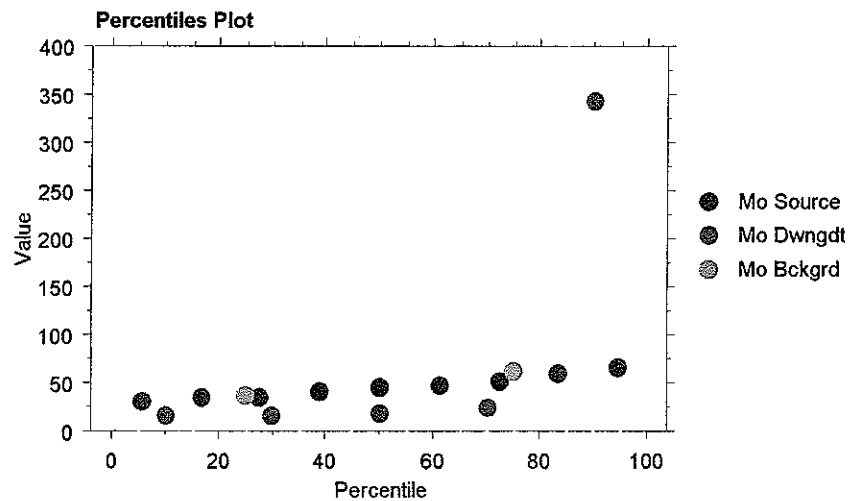


Kruskal-Wallis Test for Molybdenum
Grouping Variable: Areas

DF	2
# Groups	3
# Ties	0
H	3.602
P-Value	.1651
H corrected for ties	3.602
Tied P-Value	.1651

Kruskal-Wallis Rank Info for Molybdenum
Grouping Variable: Areas

	Count	Sum Ranks	Mean Rank
Bckgrd	2	22.000	11.000
Dwngdt	5	26.000	5.200
Source	9	88.000	9.778

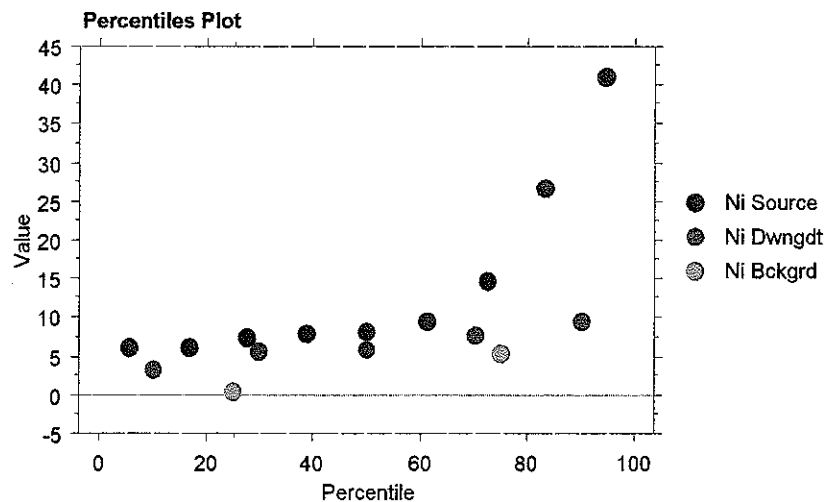


Kruskal-Wallis Test for Nickel
Grouping Variable: Areas

DF	2
# Groups	3
# Ties	1
H	7.408
P-Value	.0246
H corrected for ties	7.419
Tied P-Value	.0245

Kruskal-Wallis Rank Info for Nickel
Grouping Variable: Areas

	Count	Sum Ranks	Mean Rank
Bckgrd	2	4.000	2.000
Dwngdt	5	32.000	6.400
Source	9	100.000	11.111



Kruskal-Wallis Test for Selenium

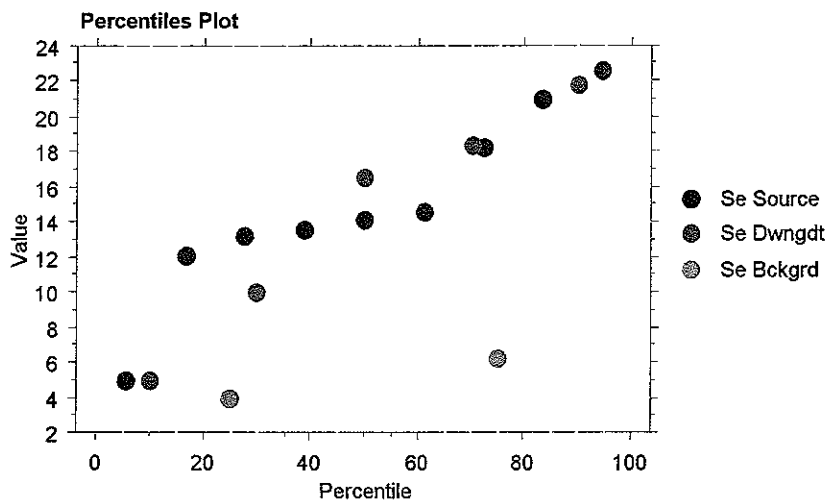
Grouping Variable: Areas

DF	2
# Groups	3
# Ties	1
H	3.631
P-Value	.1627
H corrected for ties	3.637
Tied P-Value	.1623

Kruskal-Wallis Rank Info for Selenium

Grouping Variable: Areas

	Count	Sum Ranks	Mean Rank
Bckgrd	2	5.000	2.500
Dwngdt	5	46.500	9.300
Source	9	84.500	9.389



Kruskal-Wallis Test for Vanadium

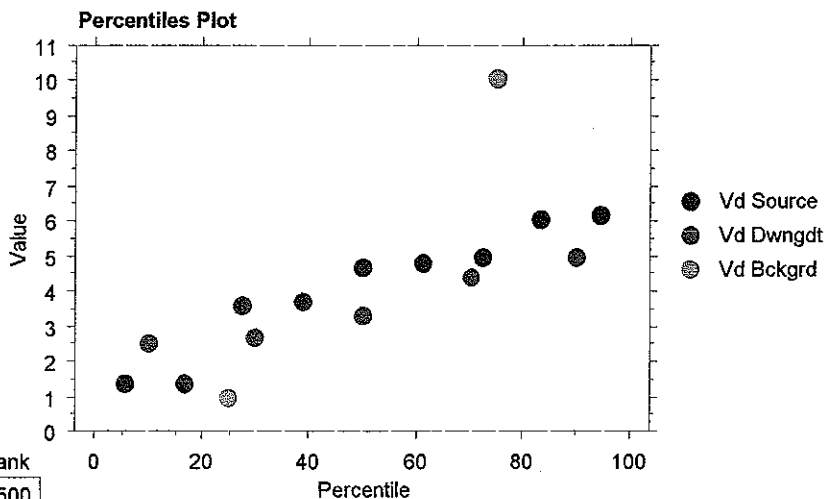
Grouping Variable: Areas

DF	2
# Groups	3
# Ties	2
H	.494
P-Value	.7811
H corrected for ties	.496
Tied P-Value	.7805

Kruskal-Wallis Rank Info for Vanadium

Grouping Variable: Areas

	Count	Sum Ranks	Mean Rank
Bckgrd	2	17.000	8.500
Dwngdt	5	36.500	7.300
Source	9	82.500	9.167



Kruskal-Wallis Test for Zinc

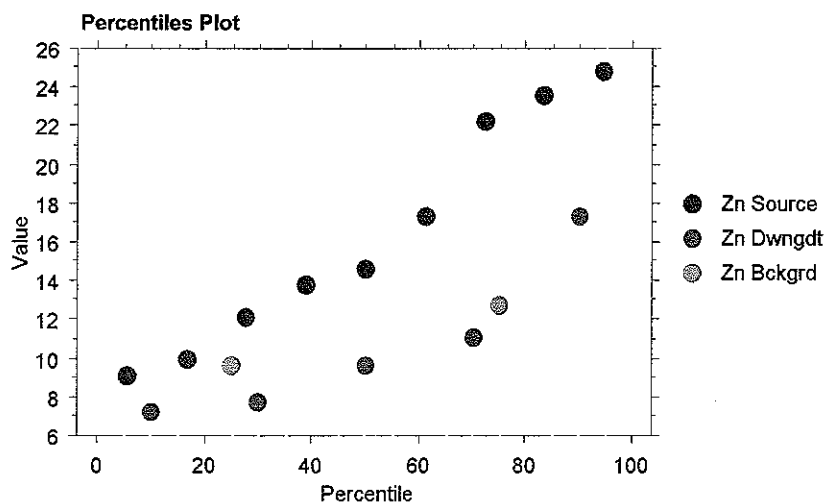
Grouping Variable: Areas

DF	2
# Groups	3
# Ties	2
H	4.160
P-Value	.1250
H corrected for ties	4.172
Tied P-Value	.1242

Kruskal-Wallis Rank Info for Zinc

Grouping Variable: Areas

	Count	Sum Ranks	Mean Rank
Bckgrd	2	13.500	6.750
Dwngdt	5	27.000	5.400
Source	9	95.500	10.611



Appendix K
Fate and Transport Documentation

Inputs to Soil Leaching Models
Naval and Marine Corps Reserve Center, LA

Data Inputs - HELP model (EPA, 1995)

1 Climatologic Inputs

Precipitation	default values for LA, 1985-1989
Temperature	default values for LA, 1985-1989
Solar Radiation	default values for LA, 1985-1989
Wind Speed	default values for LA, 1985-1989
Rel Humidity	default values for LA, 1985-1989

2 Soil & Design Inputs

Soil Type & Thickness	26 ft of Sandy clay (HELP soil type 10); from source area borehole log
Vegeatative Cover	poor grass cover assumed
Evap Root Zone Depth	24 inches (default for poor grass type in LA area)
Surface Slope	1% assumed
% Area for runoff	100% assumed
Runoff coefficient	calculated by HELP model

Data Inputs - VLEACH model (EPA, 1997)

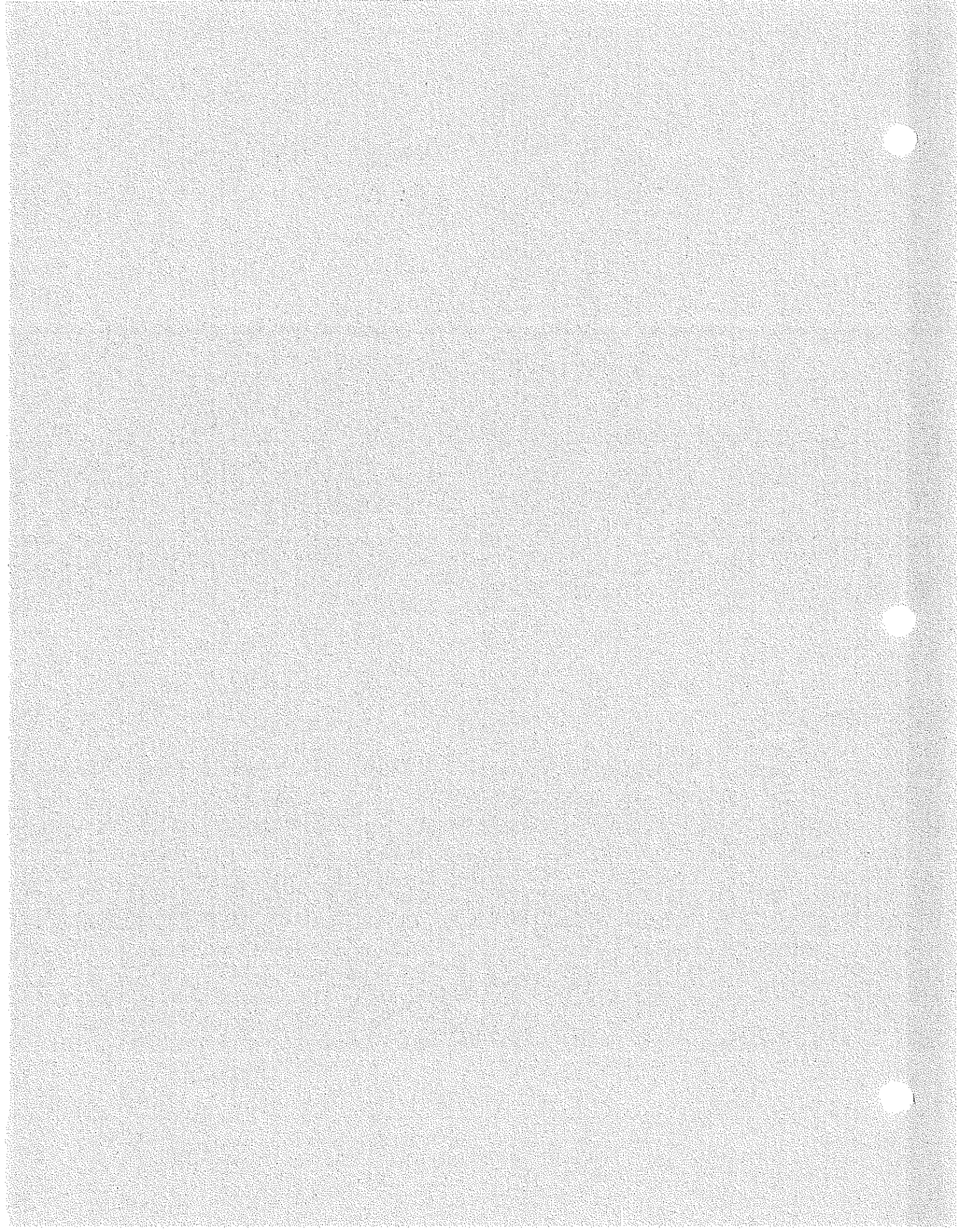
1. Soil Properties

Effective Porosity	0.1	percent; estimated from site data
Volumetric water content	0.1	percent; estimated from site data
Organic Carbon (foc)	0.00069	from site soil samples
bulk density	1.6	g/mL; estimated from site data
recharge rate	0.172 ft/yr (wet case); 0.042 ft/yr (dry case) - from HELP model output	
soil thickness	26 ft	based on GG01 borehole log

2 Contaminant Properties

	1,2 DCA	Benzene	TMB	Napthalene	Lead
Koc (mL/g)	71	89	799	1300	11.3
Solubility (mg/L)	8524	1780	20	30.8	10000
max soil conc (ug/Kg)	12	698	27200	1700	7600
conc in rechrg water (ug/L)	0	0	0	0	0
air diffusion coeff (m^2/day)	0	0	0	0	0

Site Hydrogeologic and HELP Model Inputs and Results



**
**
**
** HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE **
** HELP MODEL VERSION 3.04 (10 APRIL 1995) **
** DEVELOPED BY ENVIRONMENTAL LABORATORY **
** USAE WATERWAYS EXPERIMENT STATION **
** FOR USEPA RISK REDUCTION ENGINEERING LABORATORY **
**

PRECIPITATION DATA FILE: x:\programs\help_304\DATA4.D4
TEMPERATURE DATA FILE: x:\programs\help_304\DATA7.D7
SOLAR RADIATION DATA FILE: x:\programs\help_304\DATA13.D13
EVAPOTRANSPIRATION DATA: x:\programs\help_304\DATA11.D11
SOIL AND DESIGN DATA FILE: x:\programs\help_304\data101a.D10
OUTPUT DATA FILE: x:\programs\help_304\LA2.OUT

TIME: 15:25 DATE: 5/ 1/2000

TITLE: Marine Reserve Center, LA - Infiltration Calculations

NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

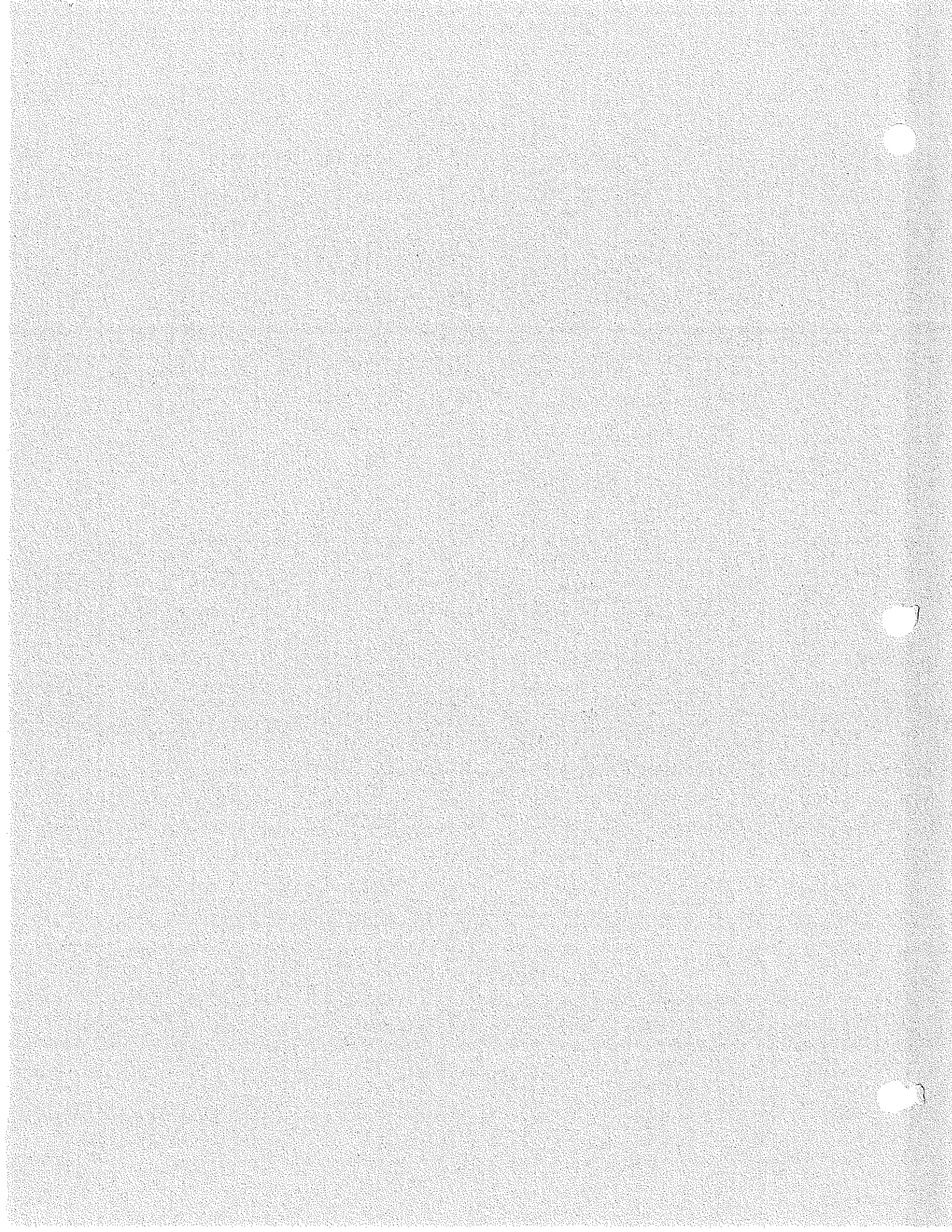
LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 10
THICKNESS = 168.00 INCHES
POROSITY = 0.3980 VOL/VOL
FIELD CAPACITY = 0.2440 VOL/VOL
WILTING POINT = 0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.2349 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.119999997000E-03 CM/SEC
NOTE: SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY 3.00
FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
SOIL DATA BASE USING SOIL TEXTURE #10 WITH A
POOR STAND OF GRASS, A SURFACE SLOPE OF 1.%

VLEACH Model Inputs and Results



Comparison of Leachate vs existing groundwater concentrations:
Navy & Marine Corps Reserve Center, L.A.

	1,2 DCA	Benzene	1,3,5 TMBz	Naphthalene	Lead
Max. Leachate Conc, wet case (ug/L; from VLEACH)	76	3955	31219	3706	471
Max. Leachate Conc, dry case (ug/L; from VLEACH)	40	2068	16268	811	245
Max GW conc (ug/L; 5-10-00 Draft Rpt & well ID	28 MW01	588 GG01	1450 GG01	120 GG01	16.8 GG01

Mean K_{OC} Tabulation Sheet for Various VOC compounds

Compound	K _{OC} (L/Kg)	Geometric Mean	Comments
1,2-DCA	33 to 152	71	
Benzene	87.1	89	
	83		
	190		
	62		
	72		
	79		
	89		
1,2,3-trimethylbenzene	884	799	For TMB isomer class
1,2,4-trimethylbenzene	884		
	772		
1,3,5-trimethylbenzene	676		

Raw K_{OC} data Source: USEPA (1998) Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water. Office of Research and Development. EPA/600/R-98/128. September. Tables B.2.1 and B.2.2.

TECHNICAL PROTOCOL FOR EVALUATING NATURAL ATTENUATION OF CHLORINATED SOLVENTS IN GROUND WATER

by

Todd H. Wiedemeier
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NATIONAL RISK MANAGEMENT RESEARCH LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
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CINCINNATI, OHIO 45268



Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water

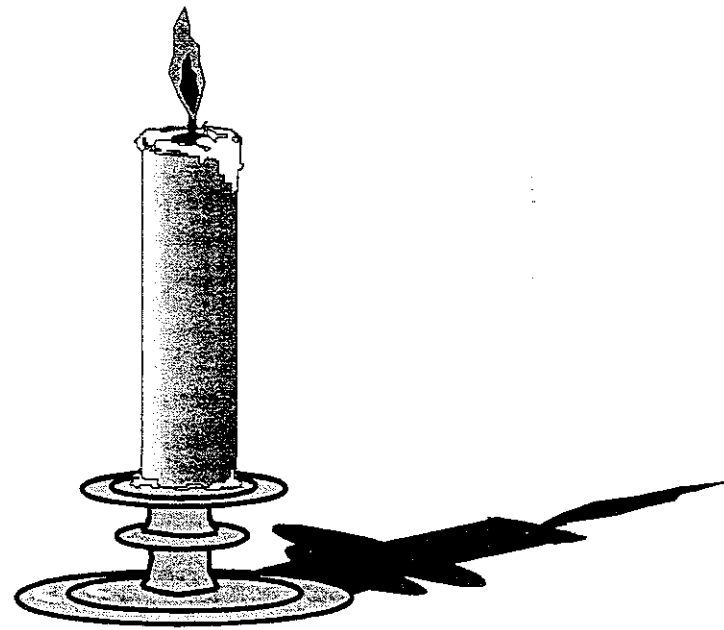


Table B.2.1 Values of Aqueous Solubility and K_{oc} for Selected Chlorinated Compounds

Compound	Solubility (mg/L)	K_{oc} (L/Kg)
Tetrachloroethene	150 ^a	263 ^a
Tetrachloroethene		359 ^b
Tetrachloroethene	1,503 ^c	209 - 238 ^c
Trichloroethene	1,100 ^a	107 ^a
Trichloroethene		137 ^b
Trichloroethene	1,100 ^c	87 - 150 ^c
1,1-Dichloroethene	2,250 ^a	64.6 ^a
1,1-Dichloroethene		80.2 ^b
1,1-Dichloroethene	2,500 ^d	150 ^d
cis-1,2-Dichloroethene		80.2 ^b
cis-1,2-Dichloroethene	3,500 ^c	49 ^c
trans-1,2-Dichloroethene	6,300 ^a	58.9 ^a
trans-1,2-Dichloroethene		80.2 ^b
trans-1,2-Dichloroethene	6,300 ^c	36 ^c
Vinyl Chloride	1,100 ^a	2.45 ^a
Vinyl Chloride	2,763 ^d	0.4 - 56 ^d
1,1,1-Trichloroethane	1,495 ^c	183 ^c
1,1,2-Trichloroethane	4,420 ^c	70 ^c
1,1-Dichloroethane	5,060 ^d	40 ^d
1,2-Dichloroethane	8,520 ^c	33 to 152 ^c
Chloroethane	5,710 ^e	33 to 143 ^e
Hexachlorobenzene	0.006 ^f	--
1,2-Dichlorobenzene	156 ^c	272 - 1480 ^c
1,3-Dichlorobenzene	111 ^g	293 to 31,600 ^g
1,4-Dichlorobenzene	74 to 87 ^d	273 to 1833 ^d
Chlorobenzene	472 ^d	83 to 389 ^d
Carbon Tetrachloride	805 ^g	110 ^g
Chloroform	7,950 ^c	<34 ^c
Methylene Chloride	13,000 ^c	48 ^c

^a From Knox et al., 1993
^b From Jeng et al., 1992; Temperature = 20°C
^c From Howard, 1990; Temperature = 25°C
^d From Howard, 1989; Temperature = 25°C
^e From Howard, 1989; Temperature = 20°C
^f ATSDR, 1990; Temperature = 20°C
^g From Howard, 1990; Temperature = 20°C

Table B.2.2 Values of Aqueous Solubility and K_{oc} for BTEX and Trimethylbenzene Isomers

Compound	Solubility (mg/L)	K_{oc} (L/Kg)
Benzene	1750 ^a	87.1 ^a
Benzene		83 ^b
Benzene	1780 ^c	190 ^{c,d,f}
Benzene	1780 ^c	62 ^{c,e,f}
Benzene	1780 ^h	72 ^{h,i}
Benzene*	1780 ^h	79 ^{h,j,*}
Benzene	1780 ^{c,h}	89 ^k
Toluene	515 ^a	151 ^a
Toluene		303 ^b
Toluene	537 ^c	380 ^{c,d,f}
Toluene	537 ^c	110 ^{c,e,f}
Toluene*	537 ^c	190 ^{k,*}
Ethylbenzene	152 ^a	158.5 ^a
Ethylbenzene		519 ^b
Ethylbenzene	167 ^c	680 ^{c,d,f}
Ethylbenzene	167 ^c	200 ^{c,e,f}
Ethylbenzene	140 ^h	501 ^{h,i}
Ethylbenzene*	140 ^h	468 ^{h,j}
Ethylbenzene	167 ^c	398 ^k
o-xylene	152 ^a	128.8 ^a
o-xylene		519 ^b
o-xylene*	152 ^a	422 ^{k,*}
m-xylene	158 ^a	
m-xylene		519 ^b
m-xylene	162 ^c	720 ^{c,d,f}
m-xylene	162 ^c	210 ^{c,e,f}
m-xylene*	162 ^c	405.37 ^{k,*}
p-xylene	198 ^a	204 ^a
p-xylene		519 ^b
p-xylene*	198 ^a	357 ^{k,*}
1,2,3-trimethylbenzene*	75	884 ^{b,*}
1,2,4-trimethylbenzene	59 ⁱ	884 ^b
1,2,4-trimethylbenzene*	59 ⁱ	772 ^{k,*}
1,3,5-trimethylbenzene*	72.60 ^g	676 ^{k,*}

^a From Knox et al., 1993
^b From Jeng et al., 1992; Temperature = 20°C
^c From Lyman et al., 1992; Temperature = 25°C
^d Estimated from K_{ow}
^e Estimated from solubility
^f Estimate from solubility generally considered more reliable
^g From Lyman et al., 1992; Temperature = 20°C
^h From Fetter, 1993
ⁱ Average of 12 equations used to estimate K_{oc} from K_{ow} or K_{nm}
^j Average of 5 equations used to estimate K_{oc} from Solubility
^k Average using equations from Kenaga and Goring (1980), Means et al (1980), and Hassett et al. (1983) to estimate K_{oc} from solubility
^l From Sutton and Calder (1975)
* Recommended value

TASK 1 Kd

$$1. K_d = \frac{C_{Pb\text{ Soil } E}}{C_{Pb\text{ Soln}}} \quad \text{or} \quad C_{Pb\text{ Soil } E} = K_d * C_{Pb\text{ Soln}}$$

where $C_{Pb\text{ Soil } E}$ = Concentration of lead in the soil at equilibrium (after leaching) (mg/kg)

$C_{Pb\text{ Soln}}$ = Concentration of lead in "NET" soln (mg/L)

$$2. C_{Pb\text{ Soil } I} * M_{\text{soil}} = (C_{Pb\text{ Soil } E} * M_{\text{soil}}) + (C_{Pb\text{ Soln}} * V_{\text{soln}})$$

where

$C_{Pb\text{ Soil } I}$ = concentration of lead in the soil initially (before leaching)

M_{soil} = Mass of soil used in leaching test (kg)

V_{soln} = Volume of solution used in leaching test (L)

2 equations 2 unknowns

Substitute 1 into 2

$$C_{Pb\text{ Soil } I} * M_{\text{soil}} = (K_d * C_{Pb\text{ Soln}} * M_{\text{soil}}) + (C_{Pb\text{ Soln}} * V_{\text{soln}})$$

subtract $(C_{Pb\text{ Soln}} * V_{\text{soln}})$ from both sides.

$$(C_{Pb\text{ Soil } I} * M_{\text{soil}}) - (C_{Pb\text{ Soln}} * V_{\text{soln}}) = K_d * C_{Pb\text{ Soln}} * M_{\text{soil}}$$

divide both sides by $C_{Pb\text{ Soln}} * M_{\text{soil}}$

$$K_d = \frac{(C_{Pb\text{ Soil } I} * M_{\text{soil}}) - (C_{Pb\text{ Soln}} * V_{\text{soln}})}{C_{Pb\text{ Soln}} * M_{\text{soil}}}$$

Sample ID	WET (ug/L)	Total Pb (mg/kg)	Msoil (kg)	Vsoln. (L)	Kd	TLM (ug/L)	Notes
99RC-MW02-S-1-21	70.7	5.7	1	10	70.6	570	California TTLC
99RC-DP01-S-1-20	243	7.6	1	20	11.3	380	SPLP
00-RC-DP09-1-25	150	5.6	1	10	27.3	560	California TTLC

$$\bar{X} = 36.4$$

$$\text{geom } \bar{X} = 27.9$$

$$R_{\text{lead}} = 1 + Kd \left(\frac{P_b}{n_c} \right)$$

$$= 1 + 27.9 \left(\frac{1.4 \text{ } \mu\text{g/L}}{0.10} \right)$$

$$= \underline{\underline{391.6}}$$

Purpose: Estimate biotransformation rates using Buscheck and Alcantar Approach

Groundwater Velocity 0.045 ft/day (estimated from Section **)

Retarded Contaminant Velocity

Equation $R = 1 + (\rho_b \cdot K_d) / n_t$

where

R =		coefficient of retardation (dimensionless)
ρ_b =	1.6	bulk density (g/cm ³) (estimated value for fine sand given in Table C.3.2 (USEPA, 1998))
K_d =		distribution coefficient (cm ³ /g) (see estimates below)
n_t =	0.35	porosity (dimensionless) (estimated value for fine sand in Table C.3.2 (USEPA., 1998))

$K_d = K_{oc} \cdot f_{oc}$

where K_{oc} = organic carbon-water partitioning coefficient for a particular VOC compound (L/kg)

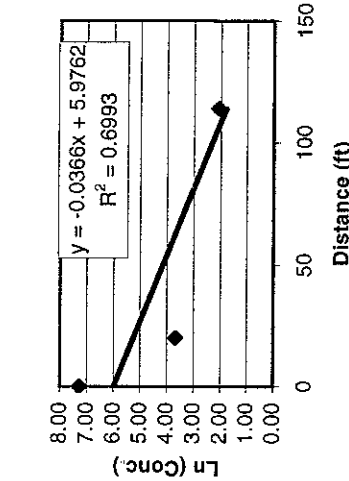
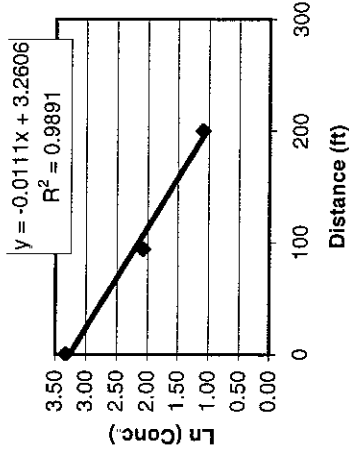
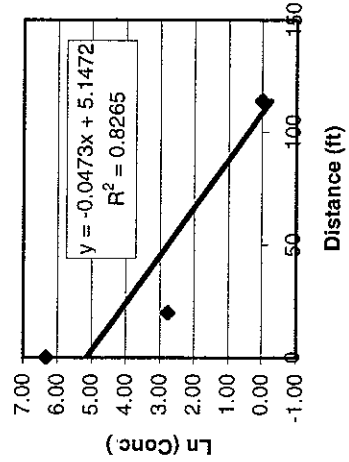
Benzene =	89	(Table B.2.1 in USEPA, 1998; Jeng et al., 1992)
1,2-DCA =	71	(Table B.2.1 in USEPA, 1998; Average value reported by Howard et al., 1990)
TMB =	799	(Table B.2.1 in USEPA, 1998; average value for 1,2,3-TMB and 1,2,4-TMB reported by Jeng et. al. 1992)

f_{oc} = fraction of organic carbon in soils, equal to the TOC in soils/1e6
Use average of TOC values collected in November 1999

Average TOC = 690 (mg/kg)
 f_{oc} = 0.00069 (dimensionless)

Contaminant Velocities (ft/yr) =	Benzene	1,2-DCA	TMB
	R =	1.28	1.22
		0.0349	0.0365
			0.0127

Buscheck and Alcantar (1995)



Contaminant	Vc (ft/day)	Dx (ft)	k/Vx (1/ft)	k (1/day)	k (1/year)	lambda (1/day)	lambda (1/yr)	Half Life (yr)
Benzene	0.0349	11.4	-0.0473	-2.11E-03	-0.77	-7.60E-04	-0.28	-2.50
1,2-DCA	0.0365	20	-0.01	-4.47E-04	-0.16	-2.92E-04	-0.11	-6.51
TMB	0.0127	11.4	-0.0366	-1.63E-03	-0.60	-2.71E-04	-0.10	-7.02

Notes:

Dx assumed equal to 0.1 times the maximum distance of the plume

The use of the Buscheck and Alcantar Method assumes that the contaminant plume has reached steady-state conditions

VLEACH (Version 2.2a, 1996)

By:

Varadhan Ravi and Jeffrey A. Johnson
(USEPA Contractors)
Center for Subsurface Modeling Support
Robert S. Kerr Environmental Research Laboratory
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

Based on the original VLEACH (version 1.0)
developed by CH2M Hill, Redding, California
for USEPA Region IX

Naval and Marine Corps Reserve Center LA - 1 2 DCA Leachate, dry case

1 polygons.

Timestep = 0.01 years. Simulation length = 50.00 years.

Printout every 0.50 years. Vertical profile stored every 1.00 years.

Koc = 71.000 ml/g, 0.25073E-02 cu.ft./g

Kh = 0.00000 (dimensionless).

Aqueous solubility = 8524.0 mg/l, 241.37 g/cu.ft

Free air diffusion coefficient = .00000 sq. m/day, .00000 sq.ft./yr

Polygon 1

Polygon 1

Polygon area = 10000. sq. ft.

26 cells, each cell 1.000 ft. thick.

Soil Properties:

Bulk density = 1.6000 g/ml, 45307. g/cu.ft.

Porosity = 0.1000 Volumetric water content = 0.1000

Organic carbon content = 0.00069000

Recharge Rate = 0.04200000 ft/yr

Conc. in recharge water = 0.00000 mg/l, 0.00000 g/cu.ft

Atmospheric concentration = 0.00000 mg/l, 0.00000 g/cu.ft

Water table has a fixed concentration of 0.00000 mg/l, 0.00000 g/cu.ft.
with respect to gas diffusion.

VLEACH (Version 2.2a, 1996)

By:
Varadhan Ravi and Jeffrey A. Johnson
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Robert S. Kerr Environmental Research Laboratory
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P.O. Box 1198
Ada, OK 74820

Based on the original VLEACH (version 1.0)
developed by CH2M Hill, Redding, California
for USEPA Region IX

Naval and Marine Corps Reserve Center LA - 1 2 DCA Leachate - wet case

1 polygons.

Timestep = 0.01 years. Simulation length = 50.00 years.

Printout every 0.50 years. Vertical profile stored every 1.00 years.

Koc = 71.000 ml/g, 0.25073E-02cu.ft./g

Kh = 0.00000 (dimensionless)

Aqueous solubility = 8524.0 mg/l, 241.37 g/cu.ft

Free air diffusion coefficient = .00000 sq. m/day, .00000 sq.ft./yr

Polygon 1

Polygon 1

Polygon area = 10000. sq. ft.

26 cells, each cell 1.000 ft. thick.

Soil Properties:

Bulk density = 1.6000 g/ml, 45307. g/cu.ft.

Porosity = 0.1000 Volumetric water content = 0.1000

Organic carbon content = 0.00069000

Recharge Rate = 0.17200001 ft/yr

Conc. in recharge water = 0.00000 mg/l, 0.00000 g/cu.ft

Atmospheric concentration = 0.00000 mg/l, 0.00000 g/cu.ft

Water table has a fixed concentration of 0.00000 mg/l, 0.00000 g/cu.ft.

with respect to gas diffusion.

VLEACH (Version 2.2a, 1996)

By:

Varadhan Ravi and Jeffrey A. Johnson
(USEPA Contractors)
Center for Subsurface Modeling Support
Robert S. Kerr Environmental Research Laboratory
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

Based on the original VLEACH (version 1.0)
developed by CH2M Hill, Redding, California
for USEPA Region IX

Naval and Marine Corps Reserve Center LA - Benzene Leachate, dry case

1 polygons.

Timestep = 0.01 years. Simulation length = 50.00 years.

Printout every 0.50 years. Vertical profile stored every 1.00 years.

Koc = 89.000 ml/g, 0.31430E-02cu ft./g

Kh = 0.00000 (dimensionless).

Aqueous solubility = 1780.0 mg/l, 50.404 g/cu.ft

Free air diffusion coefficient = .00000 sq. m/day, .00000 sq.ft./yr

Polygon 1

Polygon 1

Polygon area = 10000. sq. ft.

26 cells, each cell 1.000 ft. thick.

Soil Properties:

Bulk density = 1.6000 g/ml, 45307. g/cu.ft.

Porosity = 0.1000 Volumetric water content = 0.1000

Organic carbon content = 0.00069000

Recharge Rate = 0.04200000 ft/yr

Conc. in recharge water = 0.00000 mg/l, 0.00000 g/cu.ft

Atmospheric concentration = 0.00000 mg/l, 0.00000 g/cu.ft

Water table has a fixed concentration of 0.00000 mg/l, 0.00000 g/cu.ft.
with respect to gas diffusion.

VLEACH (Version 2.2a, 1996)

By:

Varadhan Ravi and Jeffrey A. Johnson
(USEPA Contractors)

Center for Subsurface Modeling Support
Robert S. Kerr Environmental Research Laboratory
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

Based on the original VLEACH (version 1.0)
developed by CH2M Hill, Redding, California
for USEPA Region IX

Naval and Marine Corps Reserve Center LA - Benzene Leachate - wet case

1 polygons.

Timestep = 0.01 years Simulation length = 50.00 years.

Printout every 0.50 years. Vertical profile stored every 1.00 years.

Koc = 89.000 ml/g, 0.31430E-02 cu.ft./g

Kh = 0.00000 (dimensionless).

Aqueous solubility = 1780.0 mg/l, 50.404 g/cu.ft

Free air diffusion coefficient = .00000 sq. m/day, .00000 sq.ft./yr

Polygon 1

Polygon 1

Polygon area = 10000. sq. ft.

26 cells, each cell 1.000 ft. thick.

Soil Properties:

Bulk density = 1.6000 g/ml, 45307. g/cu.ft.

Porosity = 0.1000 Volumetric water content = 0.1000

Organic carbon content = 0.00069000

Recharge Rate = 0.17200001 ft/yr

Conc. in recharge water = 0.00000 mg/l, 0.00000 g/cu.ft

Atmospheric concentration = 0.00000 mg/l, 0.00000 g/cu.ft

Water table has a fixed concentration of 0.00000 mg/l, 0.00000 g/cu.ft.

with respect to gas diffusion.

VLEACH (Version 2.2a, 1996)

By:

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P.O. Box 1198
Ada, OK 74820

Based on the original VLEACH (version 1.0)
developed by CH2M Hill, Redding, California
for USEPA Region IX

Naval and Marine Corps Reserve Center LA - 135 TrimethylBenzene Leachate, dry case
1 polygons.

Timestep = 0.01 years. Simulation length = 100.00 years.

Printout every 1.00 years. Vertical profile stored every 10.00 years.

Koc = 799.00 ml/g, 0.28216E-01cu.ft./g

Kh = 0.00000 (dimensionless)

Aqueous solubility = 20.000 mg/l, 0.56634 g/cu.ft

Free air diffusion coefficient = .00000 sq. m/day, .00000 sq.ft./yr

Polygon 1

Polygon 1

Polygon area = 10000. sq. ft.

26 cells, each cell 1.000 ft. thick.

Soil Properties:

Bulk density = 1.6000 g/ml, 45307. g/cu.ft.

Porosity = 0.1000 Volumetric water content = 0.1000

Organic carbon content = 0.00069000

Recharge Rate = 0.04200000 ft/yr

Conc. in recharge water = 0.00000 mg/l, 0.00000 g/cu.ft

Atmospheric concentration = 0.00000 mg/l, 0.00000 g/cu.ft

Water table has a fixed concentration of 0.00000 mg/l, 0.00000 g/cu.ft.
with respect to gas diffusion.

VLEACH (Version 2.2a, 1996)

By:

Varadhan Ravi and Jeffrey A. Johnson
(USEPA Contractors)

Center for Subsurface Modeling Support
Robert S. Kerr Environmental Research Laboratory
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

Based on the original VLEACH (version 1.0)
developed by CH2M Hill, Redding, California
for USEPA Region IX

Naval and Marine Corps Reserve Center LA ~ 135 TrimethylBenzene Leachate - wet case
1 polygons.

Timestep = 0.01 years. Simulation length = 100.00 years.

Printout every 1.00 years. Vertical profile stored every 10.00 years.

Koc = 799.00 ml/g, 0.28216E-01cu.ft./g

Kh = 0.00000 (dimensionless).

Aqueous solubility = 20.000 mg/l, 0.56634 g/cu.ft

Free air diffusion coefficient = .00000 sq. m/day, .00000 sq.ft./yr

Polygon 1

Polygon 1

Polygon area = 10000. sq. ft.

26 cells, each cell 1.000 ft. thick.

Soil Properties:

Bulk density = 1.6000 g/ml, 45307. g/cu.ft.

Porosity = 0.1000 Volumetric water content = 0.1000

Organic carbon content = 0.00069000

Recharge Rate = 0.17200001 ft/yr

Conc. in recharge water = 0.00000 mg/l, 0.00000 g/cu.ft

Atmospheric concentration = 0.00000 mg/l, 0.00000 g/cu.ft

Water table has a fixed concentration of 0.00000 mg/l, 0.00000 g/cu.ft.

with respect to gas diffusion.

VLEACH (Version 2.2a, 1996)

By:

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(USEPA Contractors)
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P.O. Box 1198
Ada, OK 74820

Based on the original VLEACH (version 1.0)
developed by CH2M Hill, Redding, California
for USEPA Region IX

Naval and Marine Corps Reserve Center LA - Naphthalene Leachate, dry case

1 polygons.

Timestep = 0.01 years. Simulation length = 100.00 years.

Printout every 1.00 years. Vertical profile stored every 1.00 years.

Koc = 1300.0 ml/g, 0.45909E-01cu.ft./g

Kh = 0.00000 (dimensionless)

Aqueous solubility = 30.800 mg/l, 0.87216 g/cu.ft

Free air diffusion coefficient = .00000 sq. m/day, .00000 sq.ft./yr

Polygon 1

Polygon 1

Polygon area = 10000. sq. ft.

26 cells, each cell 1.000 ft. thick.

Soil Properties:

Bulk density = 1.6000 g/ml, 45307. g/cu.ft.

Porosity = 0.1000 Volumetric water content = 0.1000

Organic carbon content = 0.00069000

Recharge Rate = 0.04200000 ft/yr

Conc. in recharge water = 0.00000 mg/l, 0.00000 g/cu.ft

Atmospheric concentration = 0.00000 mg/l, 0.00000 g/cu.ft

Water table has a fixed concentration of 0.00000 mg/l, 0.00000 g/cu.ft.
with respect to gas diffusion.

VLEACH (Version 2.2a, 1996)

By:

Varadhan Ravi and Jeffrey A. Johnson
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P.O. Box 1198
Ada, OK 74820

Based on the original VLEACH (version 1.0)
developed by CH2M Hill, Redding, California
for USEPA Region IX

Naval and Marine Corps Reserve Center LA - Naphthalene Leachate - wet case
1 polygons.

Timestep = 0.01 years. Simulation length = 100.00 years.

Printout every 1.00 years. Vertical profile stored every 1.00 years.

Koc = 1300.0 ml/g, 0.45909E-01cu.ft./g

Kh = 0.00000 (dimensionless).

Aqueous solubility = 30.800 mg/l, 0.87216 g/cu.ft

Free air diffusion coefficient = .00000 sq. m/day, .00000 sq.ft./yr

Polygon 1

Polygon 1

Polygon area = 10000. sq. ft.

26 cells, each cell 1.000 ft. thick.

Soil Properties:

Bulk density = 1.6000 g/ml, 45307. g/cu.ft.

Porosity = 0.1000 Volumetric water content = 0.1000

Organic carbon content = 0.00069000

Recharge Rate = 0.17200001 ft/yr

Conc. in recharge water = 0.00000 mg/l, 0.00000 g/cu.ft

Atmospheric concentration = 0.00000 mg/l, 0.00000 g/cu.ft

Water table has a fixed concentration of 0.00000 mg/l, 0.00000 g/cu.ft.
with respect to gas diffusion.

VLEACH (Version 2.2a, 1996)

By:
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P.O. Box 1198
Ada, OK 74820

Based on the original VLEACH (version 1.0)
developed by CH2M Hill, Redding, California
for USEPA Region IX

Naval and Marine Corps Reserve Center LA - Lead Leachate, dry case
1 polygons.
Timestep = 0.01 years Simulation length = 100.00 years.
Printout every 1.00 years. Vertical profile stored every 10.00 years.
Koc = 11.300 ml/g, 0.39905E-03cu.ft./g
Kh = 0.00000 (dimensionless).
Aqueous solubility = 10000. mg/l, 283.17 g/cu.ft
Free air diffusion coefficient = .00000 sq. m/day, .00000 sq.ft./yr

Polygon 1
Polygon 1
Polygon area = 10000. sq. ft.
26 cells, each cell 1.000 ft. thick.
Soil Properties:
Bulk density = 1.6000 g/ml, 45307. g/cu.ft.
Porosity = 0.1000 Volumetric water content = 0.1000
Organic carbon content = 1.00000000
Recharge Rate = 0.04200000 ft/yr
Conc. in recharge water = 0.00000 mg/l, 0.00000 g/cu.ft
Atmospheric concentration = 0.00000 mg/l, 0.00000 g/cu.ft
Water table has a fixed concentration of 0.00000 mg/l, 0.00000 g/cu.ft.
with respect to gas diffusion.

VLEACH (Version 2.2a, 1996)

By:
Varadhan Ravi and Jeffrey A. Johnson
(USEPA Contractors)
Center for Subsurface Modeling Support
Robert S. Kerr Environmental Research Laboratory
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

Based on the original VLEACH (version 1.0)
developed by CH2M Hill, Redding, California
for USEPA Region IX

Naval and Marine Corps Reserve Center LA - Lead Leachate - wet case

1 polygons.

Timestep = 0.01 years. Simulation length = 100.00 years.

Printout every 1.00 years. Vertical profile stored every 10.00 years.

Koc = 11.300 ml/g, 0.39905E-03cu.ft./g

Kh = 0.00000 (dimensionless).

Aqueous solubility = 10000. mg/l, 283.17 g/cu.ft

Free air diffusion coefficient = .00000 sq. m/day, .00000 sq.ft./yr

Polygon 1

Polygon 1

Polygon area = 10000. sq. ft.

26 cells, each cell 1.000 ft. thick.

Soil Properties:

Bulk density = 1.6000 g/ml, 45307. g/cu.ft.

Porosity = 0.1000 Volumetric water content = 0.1000

Organic carbon content = 1.00000000

Recharge Rate = 0.17200001 ft/yr

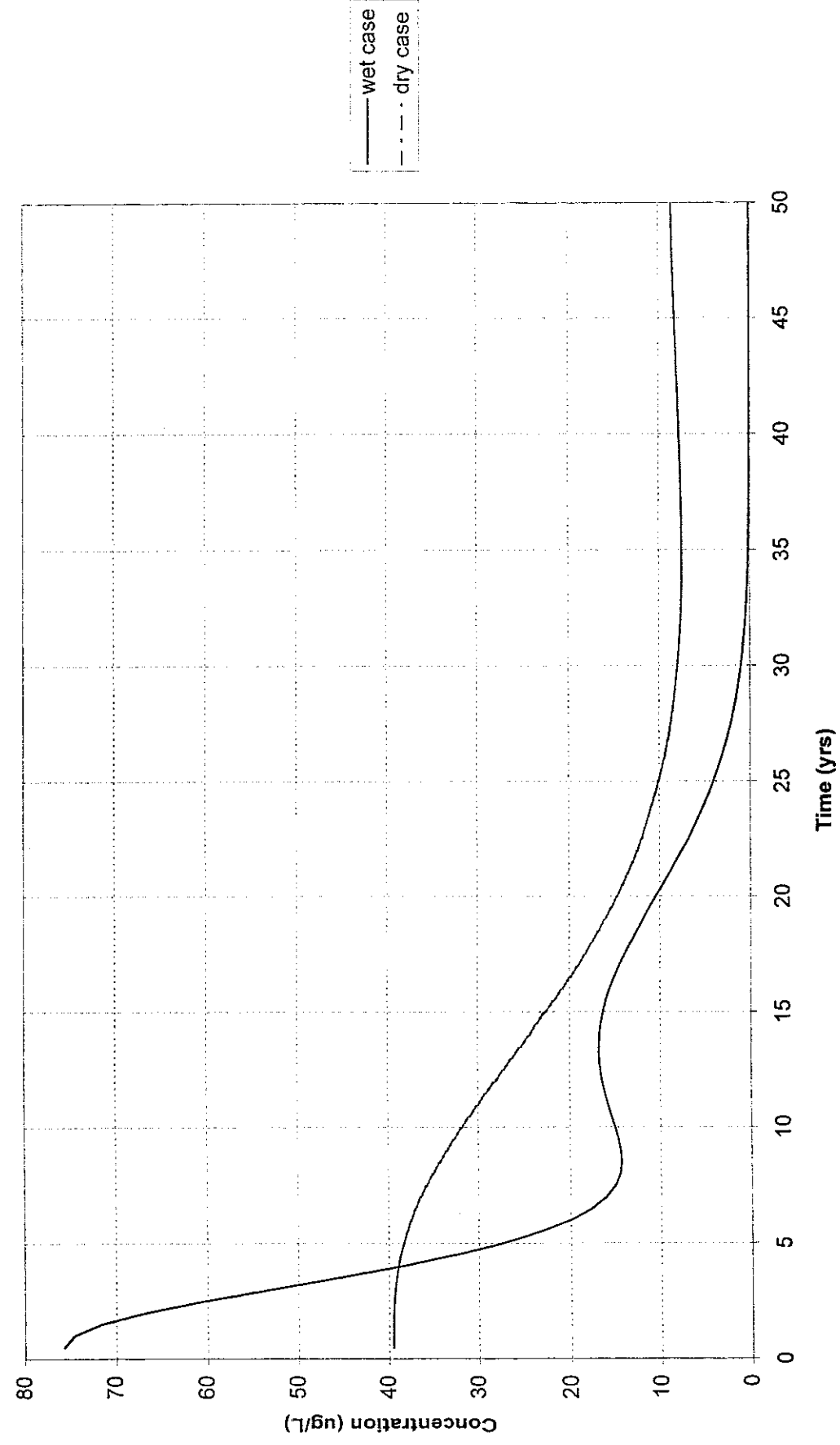
Conc. in recharge water = 0.00000 mg/l, 0.00000 g/cu.ft

Atmospheric concentration = 0.00000 mg/l, 0.00000 g/cu.ft

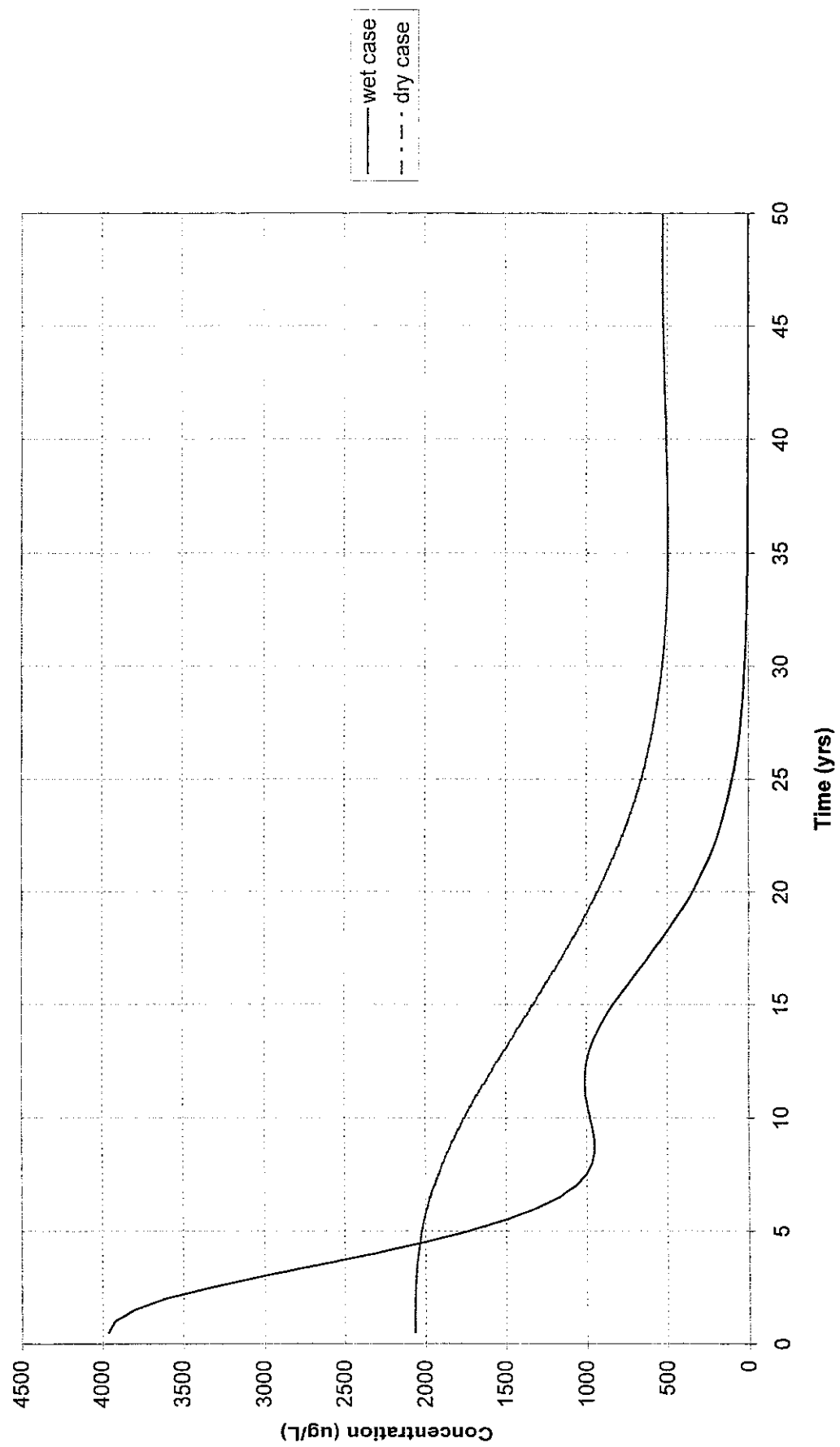
Water table has a fixed concentration of 0.00000 mg/l, 0.00000 g/cu.ft.

with respect to gas diffusion.

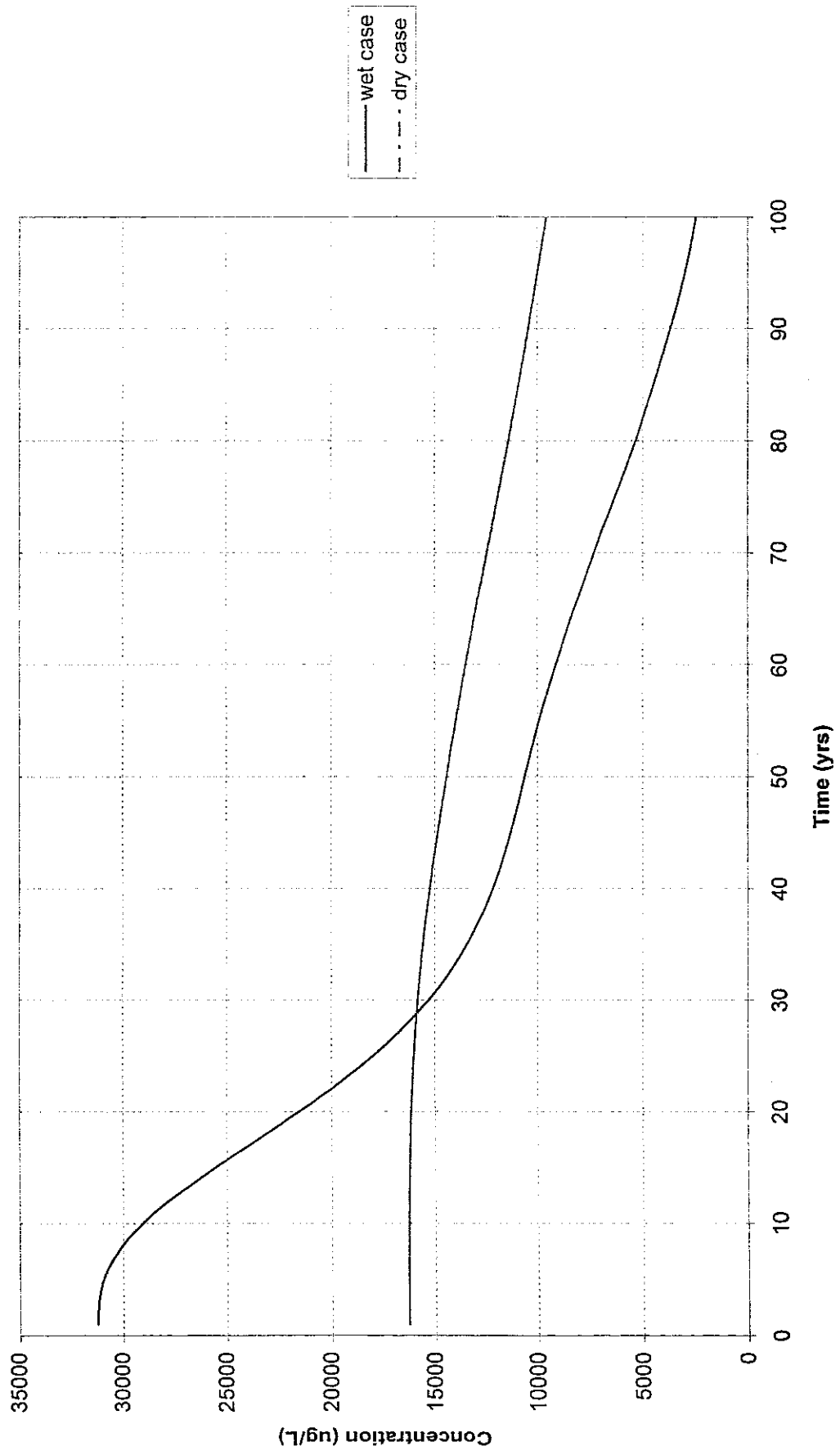
Leachate Concentrations - 1,2 DCA
Naval & Marine Corps Reserve Site, LA



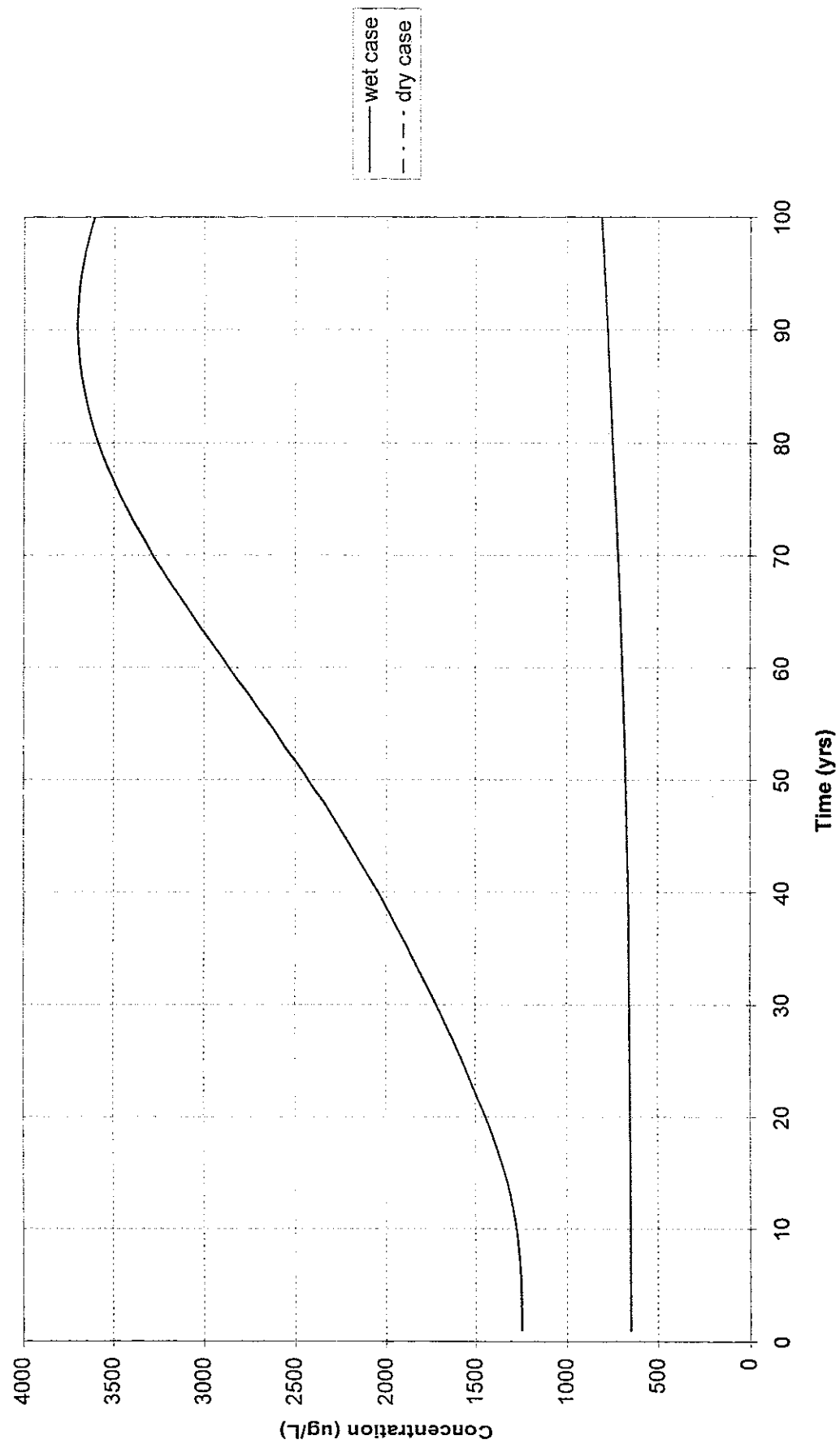
Leachate Concentrations - Benzene
Naval & Marine Corps Reserve Site, LA



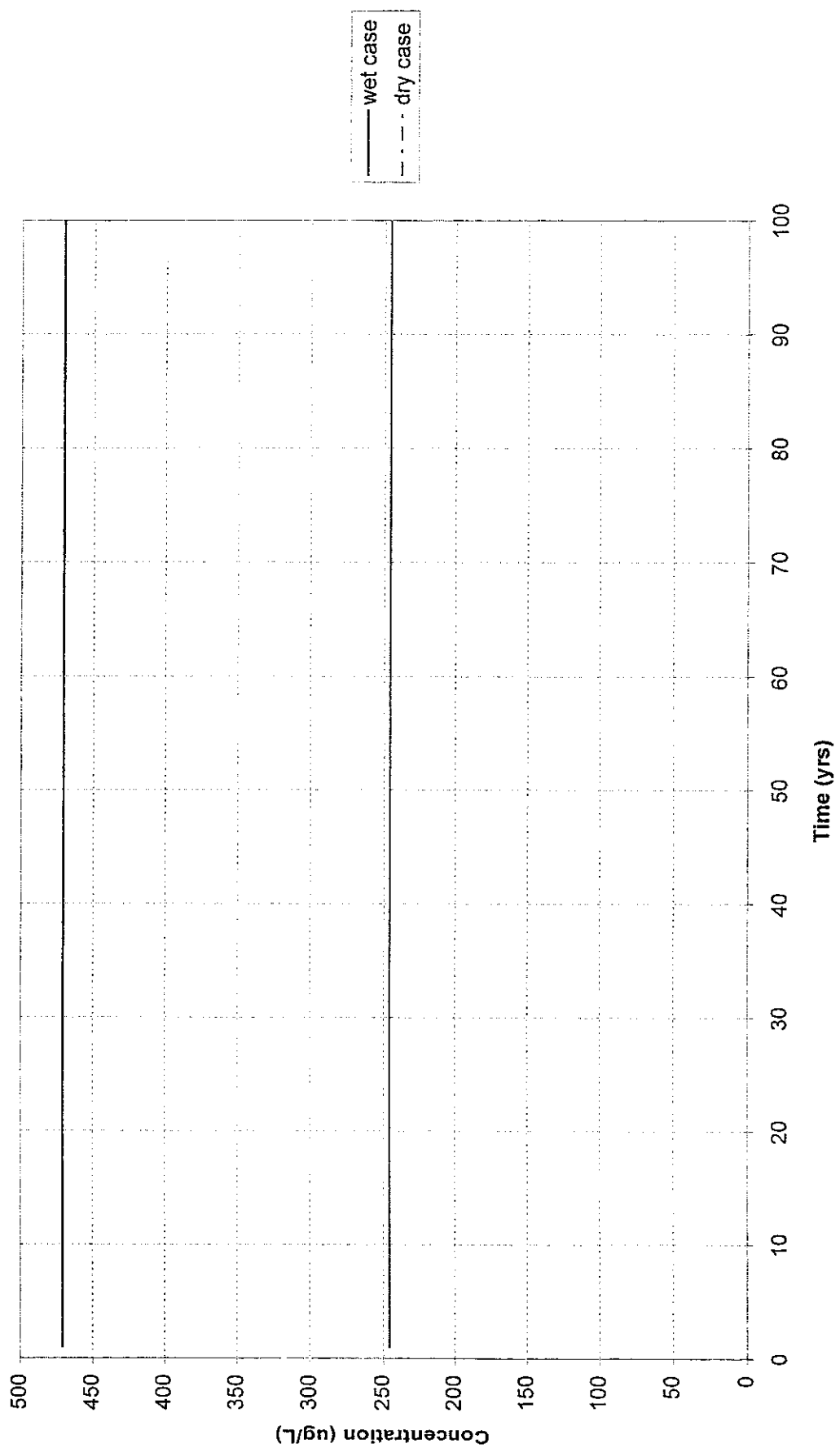
Leachate Concentrations - 1,3,5 TriMethylBenzene
Naval & Marine Corps Reserve Site, LA



Leachate Concentrations - Naphthalene
Naval & Marine Corps Reserve Site, LA



Leachate Concentrations - Lead
Naval & Marine Corps Reserve Site, LA



Comparison of Leachate vs existing groundwater concentrations:
Navy & Marine Corps Reserve Center, L.A.

	1,2 DCA	Benzene	1,3,5 TMBz	Naphthalene	Lead
Max. Leachate Conc, wet case (ug/L; from VLEACH)	76	3965	31219	3706	471
Max. Leachate Conc, dry case (ug/L; from VLEACH)	40	2068	16268	811	245
Max GW conc (ug/L; 5-10-00 Draft Rpt & well ID	28 MW01	588 GG01	1450 GG01	120 GG01	16.8 GG01

Domenico Analytical Groundwater Transport Model

Inputs and Results

Ground Water Concentrations at Property Boundary
Naval and Marine Corps Reserve Center, LA

GW Source Concentration	Concentration at Property Boundary (ug/L)		
	1,2 DCA	Benzene	TMB
Observed in gw	0	1	1
Leachate - dry case	0	2	13
Leachate - wet case	1	4	26

Notes

1. Concentrations based on 3-dimensional analytical solution of Domenico (1987) for constant source, decaying and sorbing solutes, for 50 years of transport.
2. Leachate scenarios derived from VLEACH and HELP results using 2 and 0.5 inch/yr precip for wet and dry cases, respectively.
3. TMB is ^{1,3,5} Trimethylbenzene, ~~1,2,4~~.
4. Property boundary is approximately 240 feet from the source location.

Groundwater velocity (pore-water)	$v_x := \frac{K \cdot I}{n_e}$	$v_x \approx 0.045 \frac{\text{ft}}{\text{day}}$
Contaminant velocity	$v_c := \frac{v_x}{R}$	$v_c = 0.036 \frac{\text{ft}}{\text{day}}$
Longitudinal dispersion coefficient	$D_x := \alpha_x \cdot v_x$	$D_x \approx 0.44 \frac{\text{ft}^2}{\text{day}}$
	$D_y := 0.1 \cdot D_x$	

Plume Distribution Calculation for Constant Source - DCA for Obsvd GW case

t := 1 .. 25	y := 0·ft	z := 0·ft
Δx := 20·ft		
x _i := Δx·i		
t := 50·yr	Y := 15·ft	Z := 5·ft

$$C_i := \frac{C_o}{8} \cdot \exp \left[\left(\frac{x_i}{2 \cdot \alpha_x} \right) \left(1 - \sqrt{1 + \frac{4 \cdot \lambda \cdot R \cdot \alpha_x}{v_x}} \right) \right] \cdot \left(1 - \operatorname{erf} \left[\frac{x_i - \frac{v_x}{R} \cdot t \cdot \sqrt{1 + 4 \cdot \lambda \cdot R \cdot \frac{\alpha_x}{v_x}}}{2 \cdot \sqrt{\alpha_x \cdot \frac{v_x}{R} \cdot t}} \right] \right) \cdot \left(\frac{y + \frac{Y}{2}}{2 \cdot \sqrt{\alpha_y \cdot x_i}} - \operatorname{erf} \left(\frac{y - \frac{Y}{2}}{2 \cdot \sqrt{\alpha_y \cdot x_i}} \right) \right) \cdot \left(\operatorname{erf} \left(\frac{z + \frac{Z}{2}}{2 \cdot \sqrt{\alpha_z \cdot x_i}} \right) - \operatorname{erf} \left(\frac{z - \frac{Z}{2}}{2 \cdot \sqrt{\alpha_z \cdot x_i}} \right) \right)$$

Transient ation to the Advective-Dispersive Equation for Three-D isional
Flow (Constant and Decaying Source, Variable Location, Constant Time, Solution
of Domenico, 1987, modified for Decaying Source)

Navy and Marine Corps Reserve Facility, L.A.
DCA with Co using Leachate -dry Case

Hydrogeologic Data

Hydraulic conductivity	$K := 1.275 \cdot \frac{\text{ft}}{\text{day}}$
Hydraulic gradient	$I := 0.0035 \cdot \frac{\text{ft}}{\text{ft}}$
Effective porosity	$n_e := 0.10$
Total porosity	$n := 0.35$
Longitudinal dispersivity	$\alpha_x := 3 \cdot \text{m}$
Transverse dispersivity	$\alpha_y := 0.1 \cdot \alpha_x$
Vertical dispersivity	$\alpha_z := 0.1 \cdot \alpha_y$
Initial Contaminant Concentration - Leachate, dry case	$C_o := 0.040 \cdot \frac{\text{mg}}{\text{liter}}$

Retardation Coefficient Calculation - 1.2 DCA

Dissolved Contaminant Decay Rate Constant	$\lambda := 0.11 \cdot \frac{\text{1}}{\text{yr}}$
Soil Sorption Coefficient	$K_{oc} := 71 \cdot \frac{\text{mL}}{\text{gm}}$
Particle mass density	$\rho_s := 2.65 \cdot \frac{\text{gm}}{\text{cm}^3}$
Bulk density	$\rho_b := 1.6 \cdot \frac{\text{gm}}{\text{cm}^3}$
Fraction Total Organic Carbon	$f_{oc} := 0.00069$
Retardation coefficient	$R := 1 + \frac{\rho_b \cdot K_{oc} \cdot f_{oc}}{n} \qquad R = 1.224$

Groundwater Hydraulics Calculations

Groundwater velocity (pore-water)	$v_x := \frac{K \cdot I}{n_e}$	$v_x = 0.045 \frac{\text{ft}}{\text{day}}$
Contaminant velocity	$v_c := \frac{v_x}{R}$	$v_c = 0.036 \frac{\text{ft}}{\text{day}}$
Longitudinal dispersion coefficient	$D_x := \alpha_x \cdot v_x$	$D_x = 0.439 \frac{\text{ft}^2}{\text{day}}$
	$D_y := 0.1 \cdot D_x$	

Plume Distribution Calculation for Constant Source - DCA for Leachate, dry Case

$i := 1 \dots 25$	$y := 0 \cdot \text{ft}$	$z := 0 \cdot \text{ft}$
$\Delta x := 20 \cdot \text{ft}$		
$x_i := \Delta x \cdot i$		
$t := 50 \cdot \text{yr}$	$Y := 15 \cdot \text{ft}$	$Z := 5 \cdot \text{ft}$

$$C_i := \frac{C_o}{8} \cdot \exp \left[\left(\frac{x_i}{2 \cdot \alpha_x} \right) \left(1 - \sqrt{1 + \frac{4 \cdot \lambda \cdot R \cdot \alpha_x}{v_x}} \right) \right] \cdot \left(1 - \operatorname{erf} \left[\frac{x_i - \frac{v_x}{R} \cdot t \cdot \sqrt{\frac{\alpha_x}{1 + 4 \cdot \lambda \cdot R \cdot \frac{\alpha_x}{v_x}}}}{2 \cdot \sqrt{\alpha_x \cdot \frac{v_x}{R} \cdot t}} \right] \right) \cdot \left(\operatorname{erf} \left(\frac{y + \frac{Y}{2}}{2 \cdot \sqrt{\alpha_y \cdot x_i}} \right) - \operatorname{erf} \left(\frac{y - \frac{Y}{2}}{2 \cdot \sqrt{\alpha_y \cdot x_i}} \right) \right) \cdot \left(\operatorname{erf} \left(\frac{z + \frac{Z}{2}}{2 \cdot \sqrt{\alpha_z \cdot x_i}} \right) - \operatorname{erf} \left(\frac{z - \frac{Z}{2}}{2 \cdot \sqrt{\alpha_z \cdot x_i}} \right) \right)$$

Transient solution to the Advective-Dispersive Equation for Three-Dimensional Flow (Constant and Decaying Source, Variable Location, Constant Time, Solution of Domenico, 1987, modified for Decaying Source)

Navy and Marine Corps Reserve Facility, L.A.
DCA with Co using Leachate -dry Case

Hydrogeologic Data

Hydraulic conductivity	$K := 1.275 \cdot \frac{\text{ft}}{\text{day}}$
Hydraulic gradient	$I := 0.0035 \cdot \frac{\text{ft}}{\text{ft}}$
Effective porosity	$n_e := 0.10$
Total porosity	$n := 0.35$
Longitudinal dispersivity	$\alpha_x := 3 \cdot \text{m}$
Transverse dispersivity	$\alpha_y := 0.1 \cdot \alpha_x$
Vertical dispersivity	$\alpha_z := 0.1 \cdot \alpha_y$

Initial Contaminant Concentration - Leachate, dry case	$C_o := 0.040 \cdot \frac{\text{mg}}{\text{liter}}$
--	---

Retardation Coefficient Calculation - 1.2 DCA

Dissolved Contaminant Decay Rate Constant	$\lambda := 0.11 \cdot \frac{1}{\text{yr}}$
Soil Sorption Coefficient	$K_{oc} := 71 \cdot \frac{\text{mL}}{\text{gm}}$
Particle mass density	$\rho_s := 2.65 \cdot \frac{\text{gm}}{\text{cm}^3}$
Bulk density	$\rho_b := 1.6 \cdot \frac{\text{gm}}{\text{cm}^3}$
Fraction Total Organic Carbon	$f_{oc} := 0.00069$
Retardation coefficient	$R := 1 + \frac{\rho_b \cdot K_{oc} \cdot f_{oc}}{n} \qquad R = 1.224$

Groundwater Hydraulics Calculations

Groundwater velocity (pore-water)	$v_x := \frac{K \cdot I}{n_c}$	$v_x = 0.045 \frac{\text{ft}}{\text{day}}$
Contaminant velocity	$v_c := \frac{v_x}{R}$	$v_c = 0.036 \frac{\text{ft}}{\text{day}}$
Longitudinal dispersion coefficient	$D_x := \alpha_x \cdot v_x$	$D_x = 0.439 \frac{\text{ft}^2}{\text{day}}$
	$D_y := 0.1 \cdot D_x$	

Plume Distribution Calculation for Constant Source - DCA for Leachate, dry Case

$t := 1 \dots 25$	$y := 0 \cdot \text{ft}$	$z := 0 \cdot \text{ft}$
$\Delta x := 20 \cdot \text{ft}$		
$x_i := \Delta x \cdot i$		
$t := 50 \cdot \text{yr}$	$Y := 15 \cdot \text{ft}$	$Z := 5 \cdot \text{ft}$

$$C_i := \frac{C_o}{8} \cdot \exp \left[\left(\frac{x_i}{2 \cdot \alpha_x} \right) \left(1 - \sqrt{1 + \frac{4 \cdot \lambda \cdot R \cdot \alpha_x}{v_x}} \right) \right] \cdot \left(1 - \operatorname{erf} \left[\frac{x_i - \frac{v_x}{R} \cdot t \cdot \sqrt{1 + 4 \cdot \lambda \cdot R \cdot \frac{\alpha_x}{v_x}}}{2 \cdot \sqrt{\alpha_x \cdot \frac{v_x}{R} \cdot t}} \right] \right) \cdot \left(\operatorname{erf} \left(\frac{y + \frac{Y}{2}}{2 \cdot \sqrt{\alpha_y \cdot x_i}} \right) - \operatorname{erf} \left(\frac{y - \frac{Y}{2}}{2 \cdot \sqrt{\alpha_y \cdot x_i}} \right) \right) \cdot \left(\operatorname{erf} \left(\frac{z + \frac{Z}{2}}{2 \cdot \sqrt{\alpha_z \cdot x_i}} \right) - \operatorname{erf} \left(\frac{z - \frac{Z}{2}}{2 \cdot \sqrt{\alpha_z \cdot x_i}} \right) \right)$$

Transient Solution to the Advective-Dispersive Equation for Three-Dimensional Flow (Constant and Decaying Source, Variable Location, Constant Time, Solution of Domenico, 1987, modified for Decaying Source)

Navy and Marine Corps Reserve Facility, L.A.
DCA with Co using Leachate -wet Case

Hydrogeologic Data

Hydraulic conductivity	$K := 1.275 \cdot \frac{\text{ft}}{\text{day}}$
Hydraulic gradient	$I := 0.0035 \cdot \frac{\text{ft}}{\text{ft}}$
Effective porosity	$n_e := 0.10$
Total porosity	$n := 0.35$
Longitudinal dispersivity	$\alpha_x := 3 \cdot \text{m}$
Transverse dispersivity	$\alpha_y := 0.1 \cdot \alpha_x$
Vertical dispersivity	$\alpha_z := 0.1 \cdot \alpha_y$
Initial Contaminant Concentration - Leachate, wet case	$C_0 := 0.076 \cdot \frac{\text{mg}}{\text{liter}}$

Retardation Coefficient Calculation - 1,2 DCA

Dissolved Contaminant Decay Rate Constant	$\lambda := 0.11 \cdot \frac{1}{\text{yr}}$
Soil Sorption Coefficient	$K_{oc} := 71 \cdot \frac{\text{mL}}{\text{gm}}$
Particle mass density	$\rho_s := 2.65 \cdot \frac{\text{gm}}{\text{cm}^3}$
Bulk density	$\rho_b := 1.6 \cdot \frac{\text{gm}}{\text{cm}^3}$
Fraction Total Organic Carbon	$f_{oc} := 0.00069$
Retardation coefficient	$R := 1 + \frac{\rho_b \cdot K_{oc} \cdot f_{oc}}{n} \quad P := 1.224$

Groundw Hydraulics Calculations

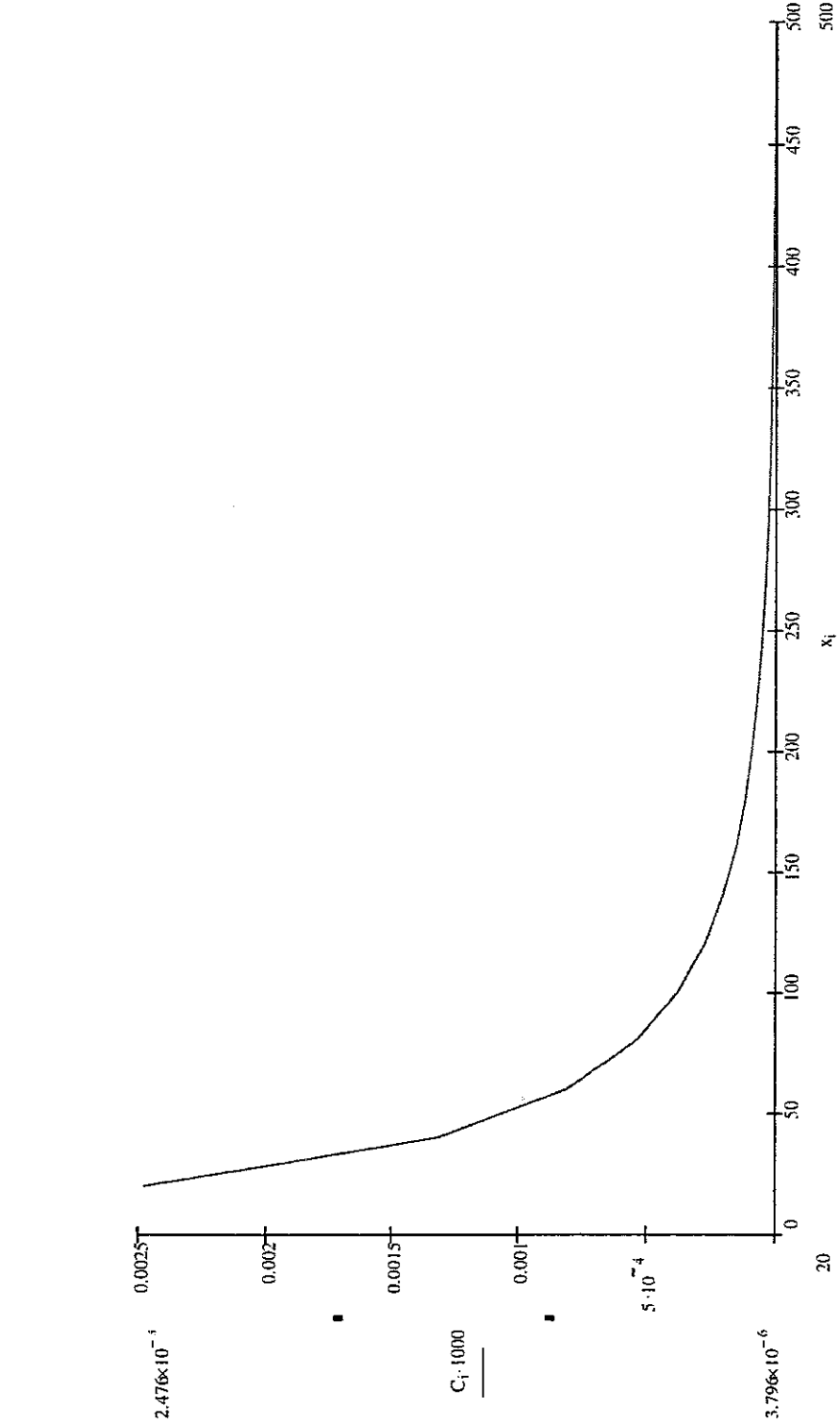
Groundwater velocity (pore-water)	$v_x := \frac{K \cdot I}{n_e}$	$v_x = 0.045 \frac{\text{ft}}{\text{day}}$
Contaminant velocity	$v_c := \frac{v_x}{R}$	$v_c = 0.036 \frac{\text{ft}}{\text{day}}$
Longitudinal dispersion coefficient	$D_x := \alpha_x \cdot v_x$	$D_x = 0.439 \frac{\text{ft}^2}{\text{day}}$
	$D_y := 0.1 \cdot D_x$	

Plume Distribution Calculation for Constant Source - DCA for Leachate, wet Case

$i := 1 \dots 25$	$y := 0 \cdot \text{ft}$	$z := 0 \cdot \text{ft}$
$\Delta x := 20 \cdot \text{ft}$		
$x_i := \Delta x \cdot i$		
$t := 50 \cdot \text{yr}$	$Y := 15 \cdot \text{ft}$	$Z := 5 \cdot \text{ft}$

$$C_i := \frac{C_o}{8} \cdot \exp \left[\left(\frac{x_i}{2 \cdot \alpha_x} \right) \left(1 - \sqrt{1 + \frac{4 \cdot \lambda \cdot R \cdot \alpha_x}{v_x}} \right) \right] \cdot \left(1 - \operatorname{erf} \left[\frac{x_i - \frac{v_x}{R} \cdot t \cdot \sqrt{1 + 4 \cdot \lambda \cdot R \cdot \frac{\alpha_x}{v_x}}}{2 \cdot \sqrt{\alpha_x \cdot \frac{v_x}{R} \cdot t}} \right] \right) \cdot \left(\left(\frac{y + \frac{Y}{2}}{2 \cdot \sqrt{\alpha_y \cdot x_i}} \right) - \operatorname{erf} \left(\frac{y - \frac{Y}{2}}{2 \cdot \sqrt{\alpha_y \cdot x_i}} \right) \right) \cdot \left(\left(\frac{z + \frac{Z}{2}}{2 \cdot \sqrt{\alpha_z \cdot x_i}} \right) - \operatorname{erf} \left(\frac{z - \frac{Z}{2}}{2 \cdot \sqrt{\alpha_z \cdot x_i}} \right) \right)$$

$C_1 =$	$x_1 =$	ft
0.04	20	
0.021	40	
0.013	60	
0.009	80	
0.006	100	
0.004	120	
0.003	140	
0.003	160	
0.002	180	
0.001	200	
0.001	220	
0.001	240	
0.001	260	
0.001	280	
0	300	
0	320	
0	340	
0	360	
0	380	
0	400	
0	420	
0	440	
0	460	
0	480	
0	500	



Transient solution to the Advective-Dispersive Equation for Three-Dimensional Flow (Constant and Decaying Source, Variable Location, Constant Time, Solution of Domenico, 1987, modified for Decaying Source)

Navy and Marine Corps Reserve Facility, L.A.
Benzene with Co using Observed Groundwater Data

Hydrogeologic Data

Hydraulic conductivity	$K := 1.275 \cdot \frac{\text{ft}}{\text{day}}$
Hydraulic gradient	$I := 0.0035 \cdot \frac{\text{ft}}{\text{ft}}$
Effective porosity	$n_e := 0.10$
Total porosity	$n := 0.35$
Longitudinal dispersivity	$\alpha_x := 3 \cdot \text{m}$
Transverse dispersivity	$\alpha_y := 0.1 \cdot \alpha_x$
Vertical dispersivity	$\alpha_z := 0.1 \cdot \alpha_y$

Initial Contaminant Concentration (Obsvd GW at GG01	$C_o := .588 \cdot \frac{\text{mg}}{\text{liter}}$
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Retardation Coefficient Calculation - Benzene

Dissolved Contaminant Decay Rate Constant	$\lambda := 0.28 \cdot \frac{1}{\text{yr}}$
Soil Sorption Coefficient	$K_{oc} := 89 \cdot \frac{\text{mL}}{\text{gm}}$
Particle mass density	$\rho_s := 2.65 \cdot \frac{\text{gm}}{\text{cm}^3}$
Bulk density	$\rho_b := 1.6 \cdot \frac{\text{gm}}{\text{cm}^3}$
Fraction Total Organic Carbon	$f_{oc} := 0.00069$
Retardation coefficient	$R := 1 + \frac{\rho_b \cdot K_{oc} \cdot f_{oc}}{n}$ $R = 1.281$

Groundwater Hydraulics Calculations

Groundwater velocity (pore-water)

$$v_x := \frac{K \cdot I}{n_e} \qquad v_x = 0.045 \frac{\text{ft}}{\text{day}}$$

Contaminant velocity

$$v_c := \frac{v_x}{R} \qquad v_c = 0.035 \frac{\text{ft}}{\text{day}}$$

Longitudinal dispersion coefficient

$$D_x := \alpha_x \cdot v_x \qquad D_x = 0.439 \frac{\text{ft}^2}{\text{day}}$$

$$D_y := 0.1 \cdot D_x$$

Plume Distribution Calculation for Constant Source -Benzene, Calculated Leachate for dry case

$$i := 1..25$$

$$\Delta x := 20 \cdot \text{ft}$$

$$y := 0 \cdot \text{ft}$$

$$z := 0 \cdot \text{ft}$$

$$x_i := \Delta x \cdot i$$

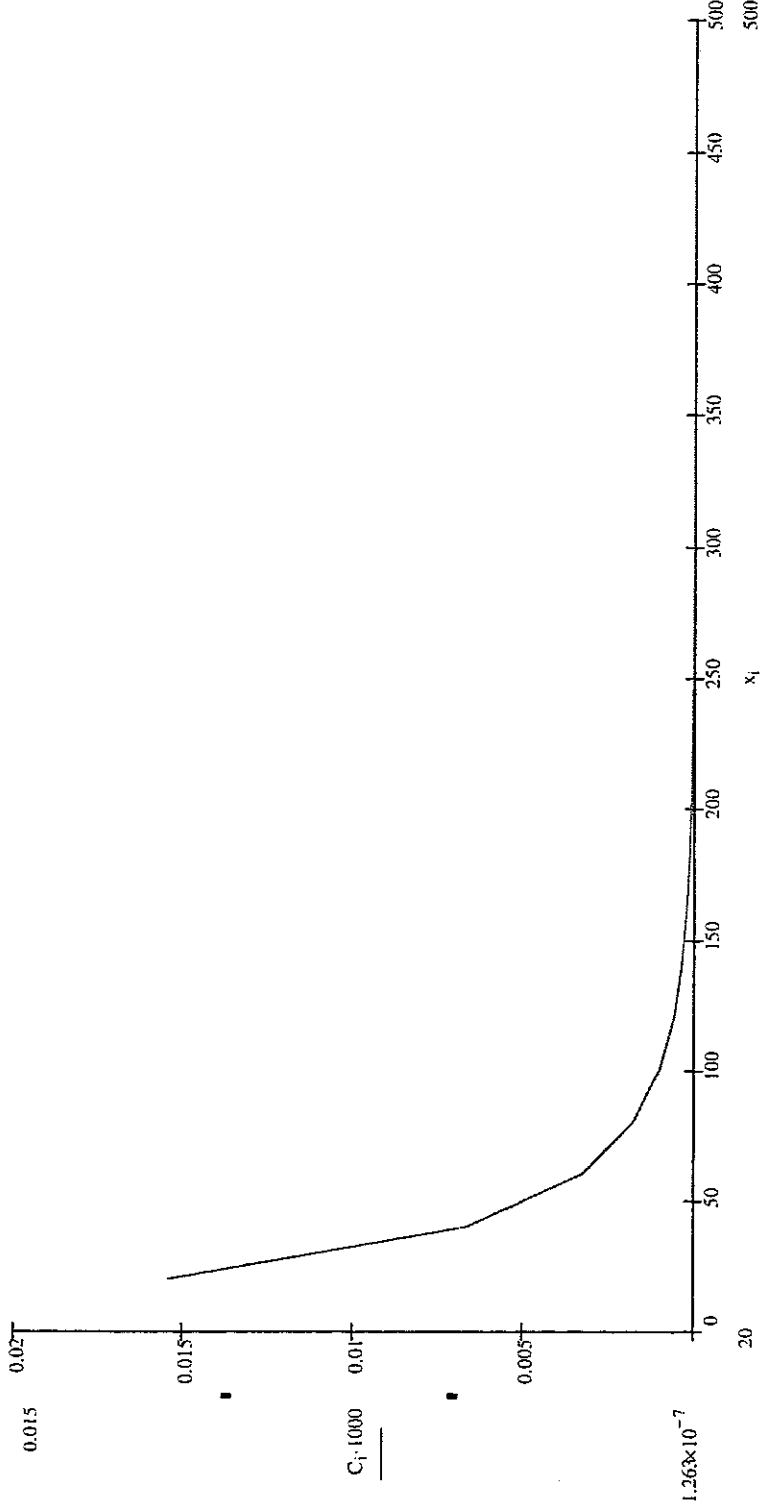
$$t := 50 \cdot \text{yr}$$

$$Y := 15 \cdot \text{ft}$$

$$Z := 5 \cdot \text{ft}$$

$$C_i := \frac{C_o}{8} \cdot \exp \left(\left[\frac{x_i}{2 \cdot \alpha_x} \right] \left(1 - \sqrt{1 + \frac{4 \cdot \lambda \cdot R \cdot \alpha_x}{v_x}} \right) \right) \cdot \left(1 - \operatorname{erf} \left(\frac{x_i - \frac{v_x}{R} \cdot t \cdot \sqrt{\frac{\alpha_x}{1 + 4 \cdot \lambda \cdot R \cdot \frac{\alpha_x}{v_x}}}}{2 \cdot \sqrt{\alpha_x \cdot \frac{v_x}{R} \cdot i}} \right) \right) \cdot \left(\left(\frac{y + \frac{Y}{2}}{2 \cdot \sqrt{\alpha_y \cdot x_i}} \right) - \operatorname{erf} \left(\frac{y - \frac{Y}{2}}{2 \cdot \sqrt{\alpha_y \cdot x_i}} \right) \right) \cdot \left(\left(\frac{z + \frac{Z}{2}}{2 \cdot \sqrt{\alpha_z \cdot x_i}} \right) - \operatorname{erf} \left(\frac{z - \frac{Z}{2}}{2 \cdot \sqrt{\alpha_z \cdot x_i}} \right) \right)$$

$C_1 =$	$\frac{\text{mg}}{\text{liter}}$	$x_1 =$ ft
	0.247	20
	0.105	40
	0.052	60
	0.028	80
	0.016	100
	0.009	120
	0.006	140
	0.003	160
	0.002	180
	0.001	200
	0.001	220
	0.001	240
	0	260
	0	280
	0	300
	0	320
	0	340
	0	360
	0	380
	0	400
	0	420
	0	440
	0	460
	0	480
	0	500



Transient Solution to the Advective-Dispersive Equation for Three-Dimensional Flow (Constant and Decaying Source, Variable Location, Constant Time, Solution of Domenico, 1987, modified for Decaying Source)

Navy and Marine Corps Reserve Facility, L.A.
Benzene with Co using Leachate - dry Case

Hydrogeologic Data

Hydraulic conductivity	$K := 1.275 \cdot \frac{\text{ft}}{\text{day}}$
Hydraulic gradient	$I := 0.0035 \cdot \frac{\text{ft}}{\text{ft}}$
Effective porosity	$n_e := 0.10$
Total porosity	$n := 0.35$
Longitudinal dispersivity	$\alpha_x := 3\text{-m}$
Transverse dispersivity	$\alpha_y := 0.1 \cdot \alpha_x$
Vertical dispersivity	$\alpha_z := 0.1 \cdot \alpha_y$
Initial Contaminant Concentration (Leachate, dry)	$C_o := 2.068 \cdot \frac{\text{mg}}{\text{liter}}$

Retardation Coefficient Calculation - Benzene

Dissolved Contaminant Decay Rate Constant	$\lambda := 0.28 \cdot \frac{1}{\text{yr}}$
Soil Sorption Coefficient	$K_{oc} := 89 \cdot \frac{\text{mL}}{\text{gm}}$
Particle mass density	$\rho_s := 2.65 \cdot \frac{\text{gm}}{\text{cm}^3}$
Bulk density	$\rho_b := 1.6 \cdot \frac{\text{gm}}{\text{cm}^3}$
Fraction Total Organic Carbon	$f_{oc} := 0.00069$
Retardation coefficient	$R := 1 + \frac{\rho_b \cdot K_{oc} \cdot f_{oc}}{n} = 1.281$

Groundwater velocity (pore-water)

$$v_x := \frac{K \cdot I}{n_e} \qquad v_x = 0.045 \frac{\text{ft}}{\text{day}}$$

Contaminant velocity

$$v_c := \frac{v_x}{R} \qquad v_c = 0.035 \frac{\text{ft}}{\text{day}}$$

Longitudinal dispersion coefficient

$$D_x := \alpha_x \cdot v_x \qquad D_x = 0.439 \frac{\text{ft}^2}{\text{day}}$$
$$D_y := 0.1 \cdot D_x$$

Plume Distribution Calculation for Constant Source -Benzene- Calculated Leachate for dry case

$$i := 1..25$$

$$\Delta x := 20 \cdot \text{ft}$$

$$x_i := \Delta x \cdot i$$

$$t := 50 \cdot \text{yr}$$

$$y := 0 \cdot \text{ft}$$

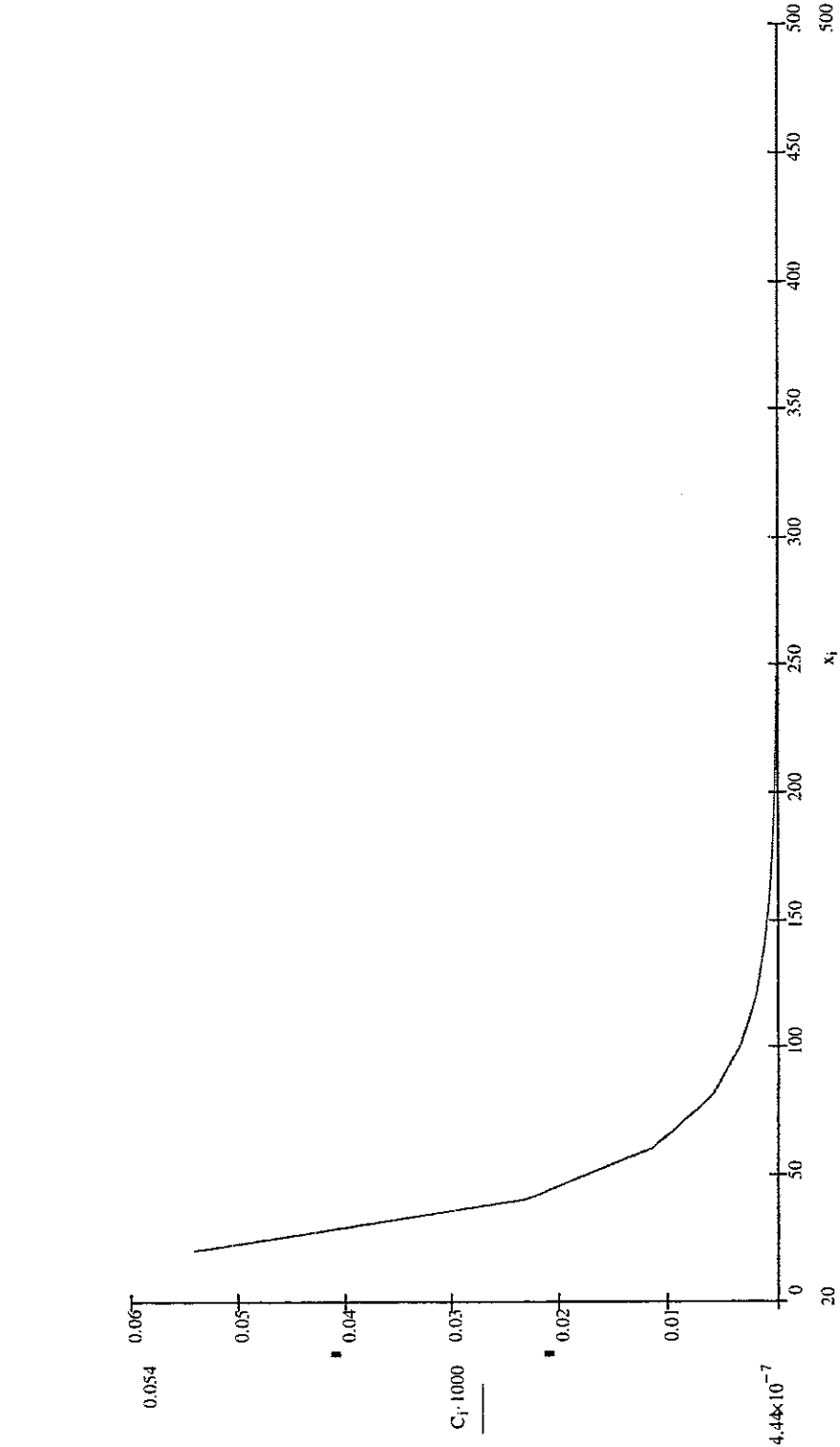
$$z := 0 \cdot \text{ft}$$

$$Y := 15 \cdot \text{ft}$$

$$Z := 5 \cdot \text{ft}$$

$$C_1 := \frac{C_0}{8} \cdot \exp \left[\left(\frac{x_i}{2 \cdot \alpha_x} \right) \left(1 - \sqrt{1 + \frac{4 \cdot \lambda \cdot R \cdot \alpha_x}{v_x}} \right) \right] \cdot \left(i - \operatorname{erf} \left(\frac{x_i - \frac{v_x}{R} \cdot t \cdot \sqrt{\frac{\alpha_x}{1 + 4 \cdot \lambda \cdot R \cdot \frac{\alpha_x}{v_x}}}}{2 \cdot \sqrt{\alpha_x \cdot \frac{v_x}{R} \cdot t}} \right) \right) \cdot \left(\left(\frac{y + \frac{Y}{2}}{2 \cdot \sqrt{\alpha_y \cdot x_i}} \right) - \operatorname{erf} \left(\frac{y - \frac{Y}{2}}{2 \cdot \sqrt{\alpha_y \cdot x_i}} \right) \right) \cdot \left(\left(\frac{z + \frac{Z}{2}}{2 \cdot \sqrt{\alpha_z \cdot x_i}} \right) - \operatorname{erf} \left(\frac{z - \frac{Z}{2}}{2 \cdot \sqrt{\alpha_z \cdot x_i}} \right) \right)$$

$C_i =$	$\frac{\text{mg}}{\text{liter}}$	$x_i =$	ft
	0.868		20
	0.371		40
	0.184		60
	0.099		80
	0.056		100
	0.033		120
	0.02		140
	0.012		160
	0.007		180
	0.005		200
	0.003		220
	0.002		240
	0.001		260
	0.001		280
	0		300
	0		320
	0		340
	0		360
	0		380
	0		400
	0		420
	0		440
	0		460
	0		480
	0		500



Transient solution to the Advective-Dispersive Equation for Three-Dimensional Flow (Constant and Decaying Source, Variable Location, Constant Time, Solution of Domenico, 1987, modified for Decaying Source)

Navy and Marine Corps Reserve Facility, L.A
Benzene with Co using Leachate - wet Case

Hydrogeologic Data

Hydraulic conductivity	$K := 1.275 \cdot \frac{\text{ft}}{\text{day}}$
Hydraulic gradient	$I := 0.0035 \cdot \frac{\text{ft}}{\text{ft}}$
Effective porosity	$n_e := 0.10$
Total porosity	$n := 0.35$
Longitudinal dispersivity	$\alpha_x := 3 \cdot \text{m}$
Transverse dispersivity	$\alpha_y := 0.1 \cdot \alpha_x$
Vertical dispersivity	$\alpha_z := 0.1 \cdot \alpha_y$
Initial Contaminant Concentration (Leachate, wet)	$C_0 := 3.965 \cdot \frac{\text{mg}}{\text{liter}}$

Retardation Coefficient Calculation - Benzene

Dissolved Contaminant Decay Rate Constant	$\lambda := 0.28 \cdot \frac{1}{\text{yr}}$
Soil Sorption Coefficient	$K_{oc} := 89 \cdot \frac{\text{mL}}{\text{gm}}$
Particle mass density	$\rho_s := 2.65 \cdot \frac{\text{gm}}{\text{cm}^3}$
Bulk density	$\rho_b := 1.6 \cdot \frac{\text{gm}}{\text{cm}^3}$
Fraction Total Organic Carbon	$f_{oc} := 0.00069$
Retardation coefficient	$R := 1 + \frac{\rho_b \cdot K_{oc} \cdot f_{oc}}{n} \quad R = 1.281$

Groundwater Hydraulics Calculations

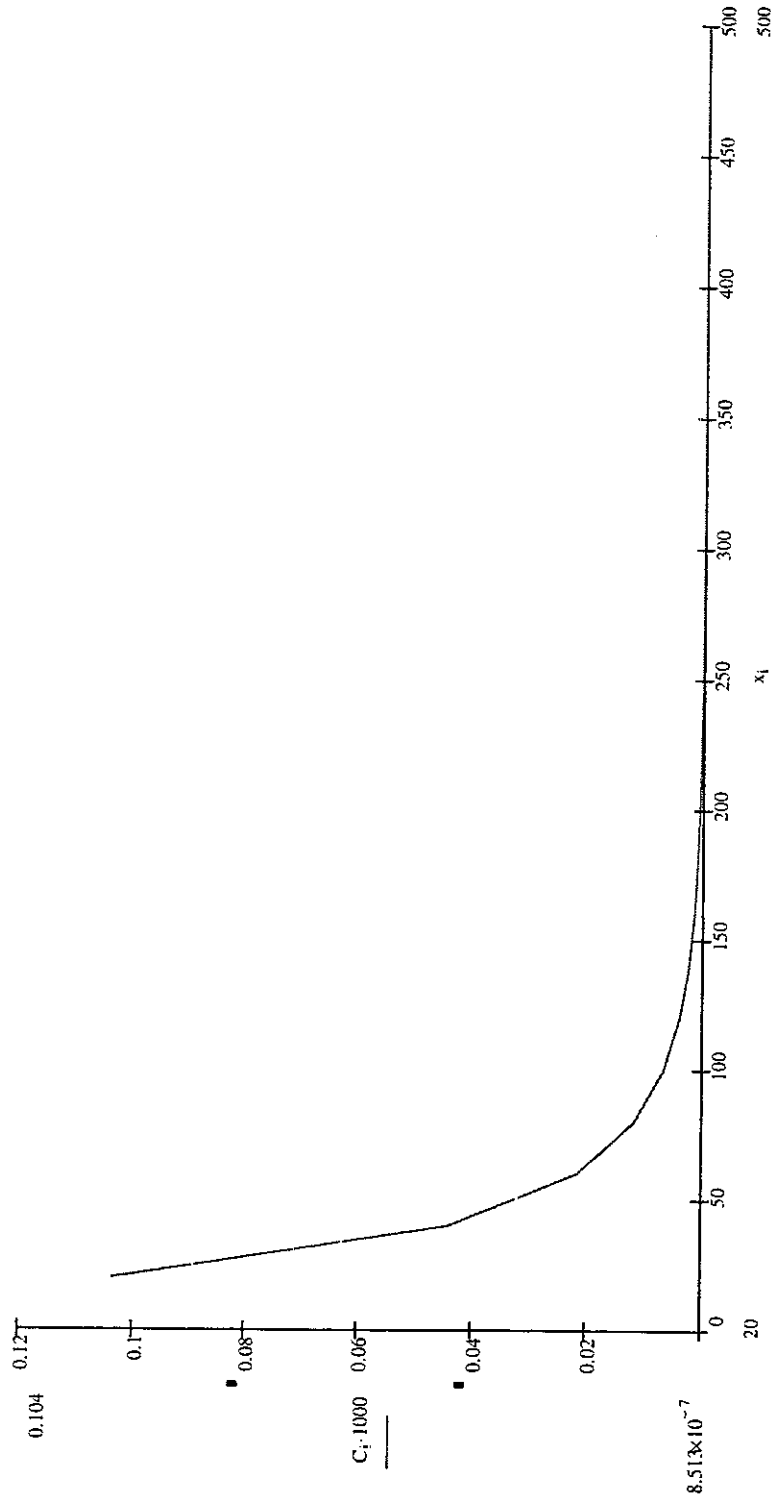
Groundwater velocity (pore-water)	$v_x := \frac{K \cdot I}{n_e}$	$v_x = 0.045 \frac{\text{ft}}{\text{day}}$
Contaminant velocity	$v_c := \frac{v_x}{R}$	$v_c = 0.035 \frac{\text{ft}}{\text{day}}$
Longitudinal dispersion coefficient	$D_x := \alpha_x \cdot v_x$	$D_x = 0.439 \frac{\text{ft}^2}{\text{day}}$
	$D_y := 0.1 \cdot D_x$	

Plume Distribution Calculation for Constant Source -Benzene, Calculated Leachate for wet case

$i := 1..25$	$y := 0\text{-ft}$	$z := 0\text{-ft}$
$\Delta x := 20\text{-ft}$		
$x_i := \Delta x \cdot i$		
$t := 50\text{-yr}$	$Y := 15\text{-ft}$	$Z := 5\text{-ft}$

$$C_i := \frac{C_o}{8} \cdot \exp \left[\left(\frac{x_i}{2 \cdot \alpha_x} \right) \left(1 - \sqrt{1 + \frac{4 \cdot \lambda \cdot R \cdot \alpha_x}{v_x}} \right) \right] \cdot \left(1 - \operatorname{erf} \left(\frac{x_i - \frac{v_x}{R} \cdot t}{2 \cdot \sqrt{\alpha_x \cdot \frac{v_x}{R} \cdot t}} \right) \right) \cdot \left(\frac{y + \frac{Y}{2}}{2 \cdot \sqrt{\alpha_y \cdot x_i}} - \operatorname{erf} \left(\frac{y - \frac{Y}{2}}{2 \cdot \sqrt{\alpha_y \cdot x_i}} \right) \right) \cdot \left(\frac{z + \frac{Z}{2}}{2 \cdot \sqrt{\alpha_z \cdot x_i}} - \operatorname{erf} \left(\frac{z - \frac{Z}{2}}{2 \cdot \sqrt{\alpha_z \cdot x_i}} \right) \right)$$

$C_i =$	$x_i =$	ft
1.663	20	
0.711	40	
0.353	60	
0.19	80	
0.107	100	
0.063	120	
0.037	140	
0.023	160	
0.014	180	
0.009	200	
0.006	220	
0.004	240	
0.002	260	
0.001	280	
0.001	300	
0.001	320	
0	340	
0	360	
0	380	
0	400	
0	420	
0	440	
0	460	
0	480	
0	500	



Transient Solution to the Advective-Dispersive Equation for Three-Dimensional Flow (Constant and Decaying Source, Variable Location, Constant Time, Solution of Domenico, 1987, modified for Decaying Source)

Navy and Marine Corps Reserve Facility, L.A. - TMB with Co using Observed Groundwater data

Hydrogeologic Data

Hydraulic conductivity	$K := 1.275 \cdot \frac{\text{ft}}{\text{day}}$
Hydraulic gradient	$I := 0.0035 \cdot \frac{\text{ft}}{\text{ft}}$
Effective porosity	$n_e := 0.10$
Total porosity	$n := 0.35$
Longitudinal dispersivity	$\alpha_x := 3 \cdot \text{m}$
Transverse dispersivity	$\alpha_y := 0.1 \cdot \alpha_x$
Vertical dispersivity	$\alpha_z := 0.1 \cdot \alpha_y$
Initial Contaminant Concentration - Obsvd gw at GG01	$C_0 := 1.45 \cdot \frac{\text{mg}}{\text{liter}}$

Retardation Coefficient Calculation - TMB

Dissolved Contaminant Decay Rate Constant	$\lambda := 0.10 \cdot \frac{1}{\text{yr}}$
Soil Sorption Coefficient	$K_{oc} := 799 \cdot \frac{\text{mL}}{\text{gm}}$
Particle mass density	$\rho_s := 2.65 \cdot \frac{\text{gm}}{\text{cm}^3}$
Bulk density	$\rho_b := 1.6 \cdot \frac{\text{gm}}{\text{cm}^3}$
Fraction Total Organic Carbon	$f_{oc} := 0.00069$
Retardation coefficient	$R := 1 + \frac{\rho_b \cdot K_{oc} \cdot f_{oc}}{n} = 3.52$

Groundwater Hydraulics Calculations

Groundwater velocity (pore-water)

$$v_x := \frac{K \cdot I}{n_e} \qquad v_x = 0.045 \frac{\text{ft}}{\text{day}}$$

Contaminant velocity

$$v_c := \frac{v_x}{R} \qquad v_c = 0.013 \frac{\text{ft}}{\text{day}}$$

Longitudinal dispersion coefficient

$$D_x := \alpha_x \cdot v_x \qquad D_x = 0.439 \frac{\text{ft}^2}{\text{day}}$$

$$D_y := 0.1 \cdot D_x$$

Plume Distribution Calculation for Constant Source - TMB, GW data

$$i := 1..25$$

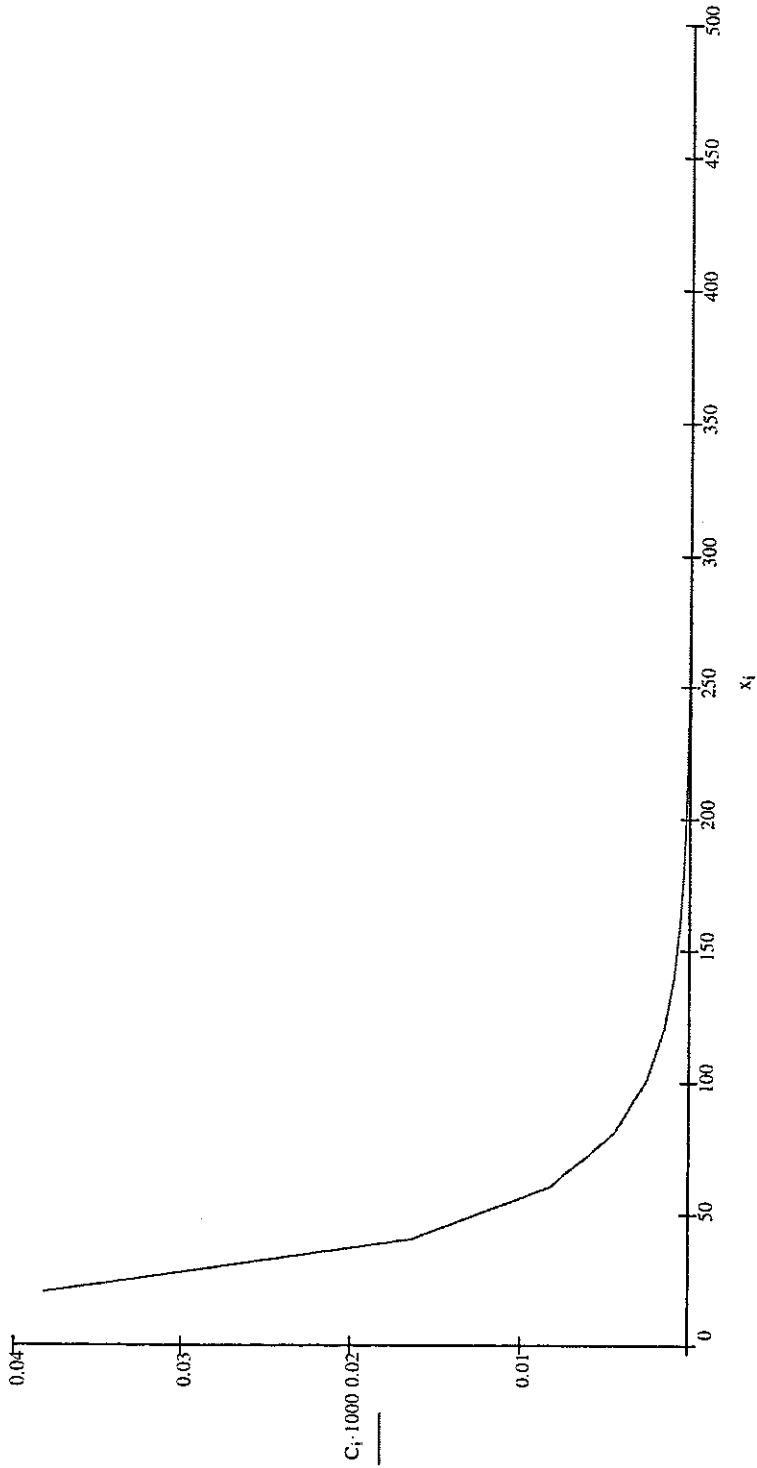
$$\Delta x := 20 \cdot \text{ft} \qquad y := 0 \cdot \text{ft} \qquad z := 0 \cdot \text{ft}$$

$$x_i := \Delta x \cdot i$$

$$t := 50 \cdot \text{yr} \qquad Y := 15 \cdot \text{ft} \qquad Z := 5 \cdot \text{ft}$$

$$C_i := \frac{C_0}{8} \cdot \exp \left[\left(\frac{x_i}{2 \cdot \alpha_x} \right) \left(1 - \sqrt{1 + \frac{4 \cdot \lambda \cdot R \cdot \alpha_x}{v_x}} \right) \right] \cdot \left(1 - \operatorname{erf} \left[\frac{x_i - \frac{v_x}{R} \cdot t \cdot \sqrt{1 + 4 \cdot \lambda \cdot R \cdot \frac{\alpha_x}{v_x}}}{2 \cdot \sqrt{\alpha_x \cdot \frac{v_x}{R} \cdot t}} \right] \right) \cdot \left(\frac{y + \frac{Y}{2}}{2 \cdot \sqrt{\alpha_y \cdot x_i}} - \operatorname{erf} \left(\frac{y - \frac{Y}{2}}{2 \cdot \sqrt{\alpha_y \cdot x_i}} \right) \right) \cdot \left(\frac{z + \frac{Z}{2}}{2 \cdot \sqrt{\alpha_z \cdot x_i}} - \operatorname{erf} \left(\frac{z - \frac{Z}{2}}{2 \cdot \sqrt{\alpha_z \cdot x_i}} \right) \right)$$

$C_i =$	$x_i =$	ft
	20	0.612
	40	0.263
	60	0.131
	80	0.071
	100	0.04
	120	0.024
	140	0.014
	160	0.009
	180	0.005
	200	0.003
	220	0.002
	240	0.001
	260	0.001
	280	0
	300	0
	320	0
	340	0
	360	0
	380	0
	400	0
	420	0
	440	0
	460	0
	480	$6.277 \cdot 10^{-8}$
	500	$1.767 \cdot 10^{-8}$



Transfer lution to the Advective-Dispersive Equation for Three-Dimensional
Flow (Constant and Decaying Source, Variable Location, Constant Time, Solution
of Domenico, 1987, modified for Decaying Source)

Navy and Marine Corps Reserve Facility, L.A. -
TMB with Co using Leachate - dry Case

Hydrogeologic Data

Hydraulic conductivity	$K := 1.275 \cdot \frac{\text{ft}}{\text{day}}$
Hydraulic gradient	$I := 0.0035 \cdot \frac{\text{ft}}{\text{ft}}$
Effective porosity	$n_e := 0.10$
Total porosity	$n := 0.35$
Longitudinal dispersivity	$\alpha_x := 3 \cdot \text{m}$
Transverse dispersivity	$\alpha_y := 0.1 \cdot \alpha_x$
Vertical dispersivity	$\alpha_z := 0.1 \cdot \alpha_y$

Initial Contaminant Concentration - Leachate, dry case	$C_o := 16.268 \cdot \frac{\text{mg}}{\text{liter}}$
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Retardation Coefficient Calculation - TMB

Dissolved Contaminant Decay Rate Constant	$\lambda := 0.10 \cdot \frac{1}{\text{yr}}$
Soil Sorption Coefficient	$K_{oc} := 799 \cdot \frac{\text{mL}}{\text{gm}}$
Particle mass density	$\rho_s := 2.65 \cdot \frac{\text{gm}}{\text{cm}^3}$
Bulk density	$\rho_b := 1.6 \cdot \frac{\text{gm}}{\text{cm}^3}$
Fraction Total Organic Carbon	$f_{oc} := 0.00069$
Retardation coefficient	$R := 1 + \frac{\rho_b \cdot K_{oc} \cdot f_{oc}}{n}$ R = 3.52

Groundwater Hydraulics Calculations

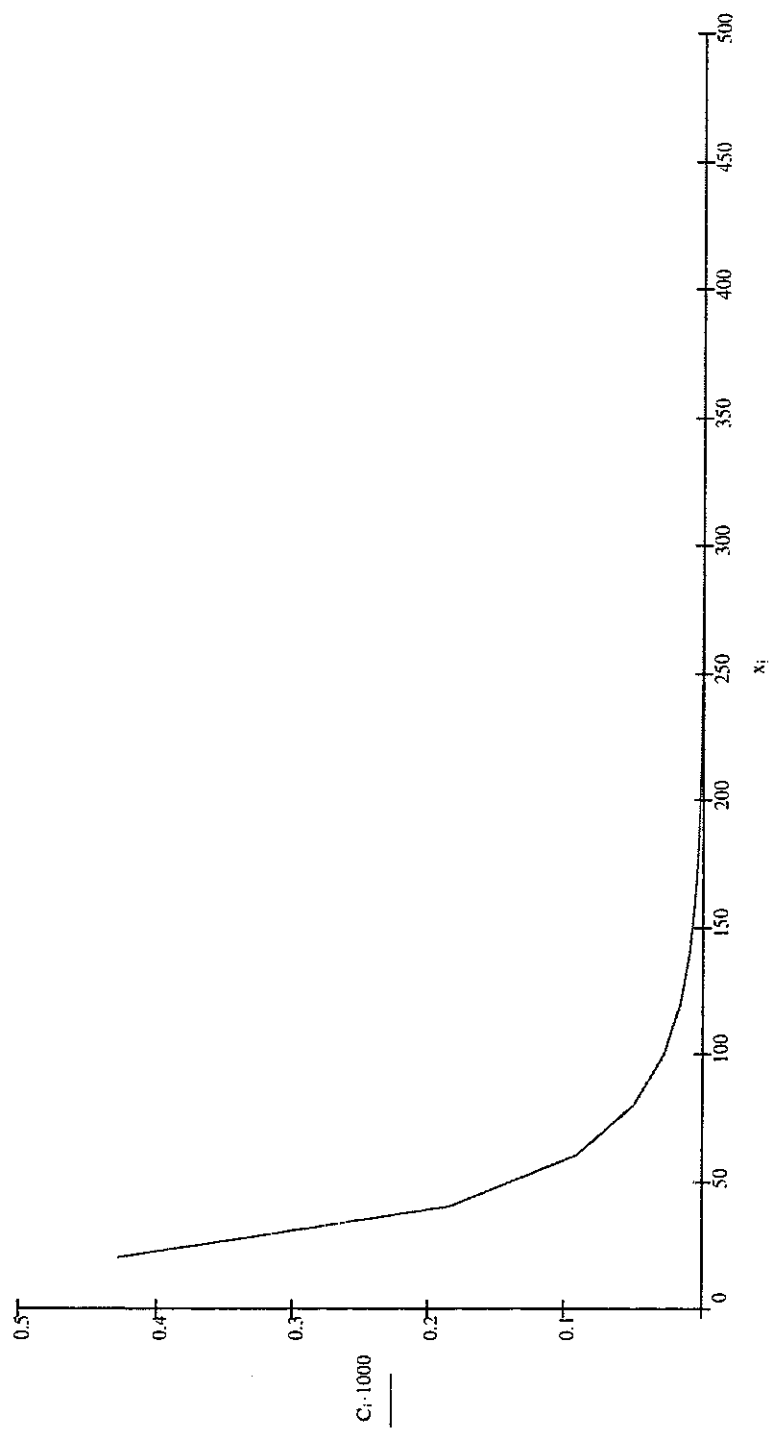
Groundwater velocity (pore-water)	$v_x := \frac{K \cdot I}{n_e}$	$v_x = 0.045 \frac{\text{ft}}{\text{day}}$
Contaminant velocity	$v_c := \frac{v_x}{R}$	$v_c = 0.013 \frac{\text{ft}}{\text{day}}$
Longitudinal dispersion coefficient	$D_x := \alpha_x \cdot v_x$	$D_x = 0.439 \frac{\text{ft}^2}{\text{day}}$
	$D_y := 0.1 \cdot D_x$	

Plume Distribution Calculation for Constant Source - TMB, Leachate, dry

$t := 1 \dots 25$	$y := 0 \cdot \text{ft}$	$z := 0 \cdot \text{ft}$
$\Delta x := 20 \cdot \text{ft}$		
$x_i := \Delta x \cdot i$		
$t := 50 \cdot \text{yr}$	$Y := 15 \cdot \text{ft}$	$Z := 5 \cdot \text{ft}$

$$C_i := \frac{C_o}{8} \cdot \exp \left[\left(\frac{x_i}{2 \cdot \alpha_x} \right) \left(1 - \sqrt{1 + \frac{4 \cdot \lambda \cdot R \cdot \alpha_x}{v_x}} \right) \right] \cdot \left(1 - \operatorname{erf} \left(\frac{x_i - \frac{v_x}{R} \cdot t \cdot \sqrt{\frac{\alpha_x}{1 + 4 \cdot \lambda \cdot R \cdot v_x}}}{2 \cdot \sqrt{\alpha_x \cdot \frac{v_x}{R} \cdot t}} \right) \right) \cdot \left(\operatorname{erf} \left(\frac{y + \frac{Y}{2}}{2 \cdot \sqrt{\alpha_y \cdot x_i}} \right) - \operatorname{erf} \left(\frac{y - \frac{Y}{2}}{2 \cdot \sqrt{\alpha_y \cdot x_i}} \right) \right) \cdot \left(\operatorname{erf} \left(\frac{z + \frac{Z}{2}}{2 \cdot \sqrt{\alpha_z \cdot x_i}} \right) - \operatorname{erf} \left(\frac{z - \frac{Z}{2}}{2 \cdot \sqrt{\alpha_z \cdot x_i}} \right) \right)$$

$C_1 =$	$x_i =$	ft
6.865	20	
2.953	40	
1.474	60	
0.798	80	
0.453	100	
0.266	120	
0.159	140	
0.097	160	
0.059	180	
0.036	200	
0.022	220	
0.013	240	
0.008	260	
0.004	280	
0.002	300	
0.001	320	
0.001	340	
0	360	
0	380	
0	400	
0	420	
0	440	
0	460	
0	480	
0	500	



Transient Solution to the Advective-Dispersive Equation for Three-Dimensional Flow (Constant and Decaying Source, Variable Location, Constant Time, Solution of Domenico, 1987, modified for Decaying Source)

Navy and Marine Corps Reserve Facility, L.A. - TMB with Co using Leachate - wet Case

Hydrogeologic Data

Hydraulic conductivity	$K := 1.275 \cdot \frac{\text{ft}}{\text{day}}$
Hydraulic gradient	$I := 0.0035 \cdot \frac{\text{ft}}{\text{ft}}$
Effective porosity	$n_e := 0.10$
Total porosity	$n := 0.35$
Longitudinal dispersivity	$\alpha_x := 3 \cdot \text{m}$
Transverse dispersivity	$\alpha_y := 0.1 \cdot \alpha_x$
Vertical dispersivity	$\alpha_z := 0.1 \cdot \alpha_y$

Initial Contaminant Concentration - Leachate, wet case	$C_o := 31.219 \cdot \frac{\text{mg}}{\text{liter}}$
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Retardation Coefficient Calculation - TMB

Dissolved Contaminant Decay Rate Constant	$\lambda := 0.10 \cdot \frac{1}{\text{yr}}$
Soil Sorption Coefficient	$K_{oc} := 799 \cdot \frac{\text{mL}}{\text{gm}}$
Particle mass density	$\rho_s := 2.65 \cdot \frac{\text{gm}}{\text{cm}^3}$
Bulk density	$\rho_b := 1.6 \cdot \frac{\text{gm}}{\text{cm}^3}$
Fraction Total Organic Carbon	$f_{oc} := 0.00069$
Retardation coefficient	$R := 1 + \frac{\rho_b \cdot K_{oc} \cdot f_{oc}}{n}$

3.52

Ground: Hydraulics Calculations

Groundwater velocity (pore-water)	$v_x := \frac{K \cdot I}{n_e}$	$v_x = 0.045 \frac{\text{ft}}{\text{day}}$
Contaminant velocity	$v_c := \frac{v_x}{R}$	$v_c = 0.013 \frac{\text{ft}}{\text{day}}$
Longitudinal dispersion coefficient	$D_x := \alpha_x \cdot v_x$	$D_x = 0.439 \frac{\text{ft}^2}{\text{day}}$
	$D_y := 0.1 \cdot D_x$	

Plume Distribution Calculation for Constant Source - TMB, Leachate, wet

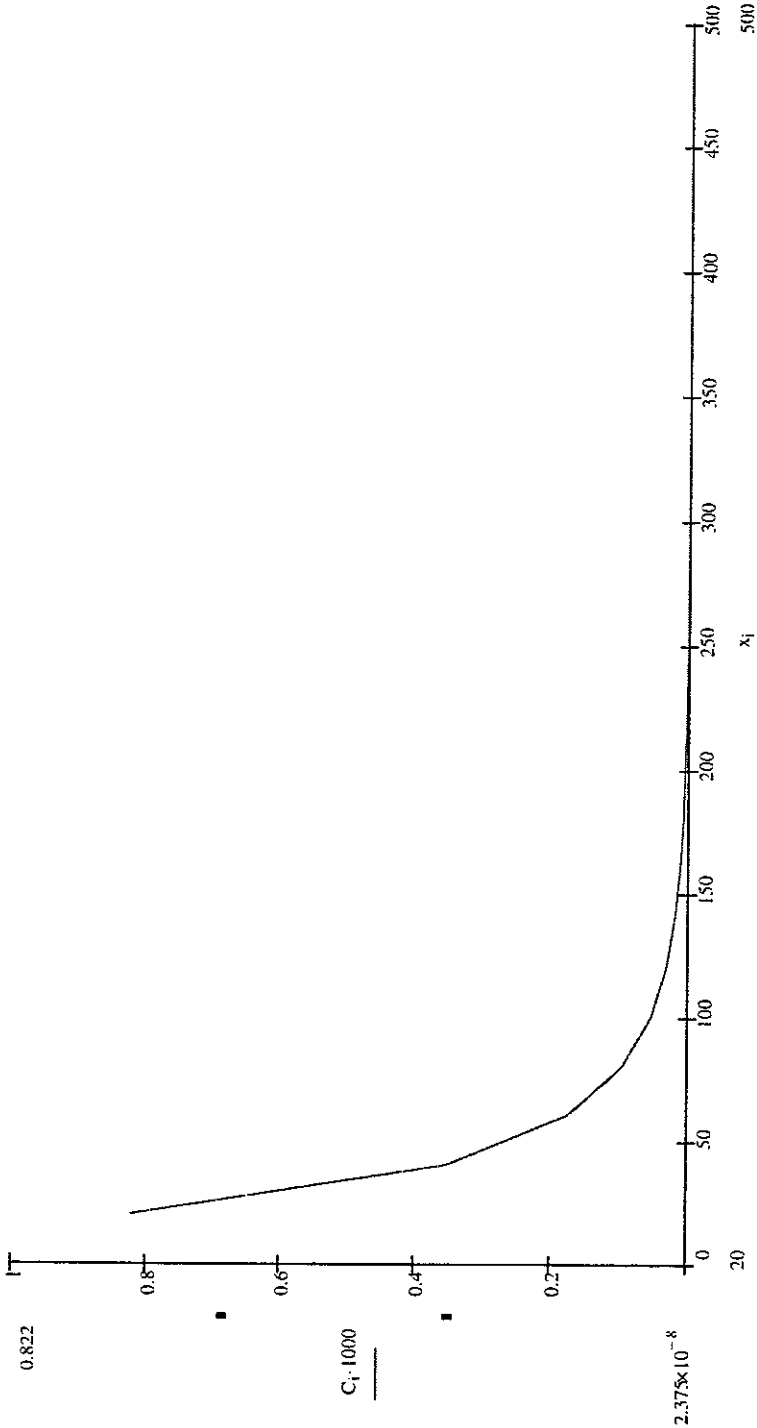
t := 1 .. 25	y := 0·ft	z := 0·ft
Δx := 20·ft		
x _i := Δx·i		
t := 50·yr	Y := 15·ft	Z := 5·ft

$$C_l := \frac{C_o}{8} \cdot \exp \left[\left(\frac{x_i}{2 \cdot \alpha_x} \right) \left(1 - \sqrt{1 + \frac{4 \cdot \lambda \cdot R \cdot \alpha_x}{v_x}} \right) \right] \cdot \left(1 - \operatorname{erf} \left[\frac{x_i - \frac{v_x}{R} \cdot t \cdot \sqrt{1 + 4 \cdot \lambda \cdot R \cdot \frac{\alpha_x}{v_x}}}{2 \cdot \sqrt{\alpha_x \cdot \frac{v_x}{R} \cdot t}} \right] \right) \cdot \left(\left(\frac{y + \frac{Y}{2}}{2 \cdot \sqrt{\alpha_y \cdot x_i}} \right) - \operatorname{erf} \left[\frac{y - \frac{Y}{2}}{2 \cdot \sqrt{\alpha_y \cdot x_i}} \right] \right) \cdot \left(\left(\frac{z + \frac{Z}{2}}{2 \cdot \sqrt{\alpha_z \cdot x_i}} \right) - \operatorname{erf} \left[\frac{z - \frac{Z}{2}}{2 \cdot \sqrt{\alpha_z \cdot x_i}} \right] \right)$$

$C_1 =$	$x_1 =$
13.174	20
5.667	40
2.83	60
1.531	80
0.869	100
0.51	120
0.306	140
0.186	160
0.114	180
0.07	200
0.043	220
0.026	240
0.015	260
0.009	280
0.005	300
0.002	320
0.001	340
0.001	360
0	380
0	400
0	420
0	440
0	460
0	480
0	500

$\frac{\text{mg}}{\text{liter}}$

ft



LA Reserve Center
Assimilative Capacity

nitrate-N (mg/L)	C H Cl			C valence	nitrate-N/compound mole/mole	MW	mg/l		mg/l delta	mM delta (mM)	NO3-N consumed			
	6	6	0				Max	Min			mM	(mg/L)		
Benzene	6	6	0	-6	6	78	42.5	0	11.5	31	2.2	0.0072	0.0429	0.6009
TMB	9	12	0	-12	9.6	120	1.45	0	0		0.0121	0.1160	1.6240	1.6240
12-DCA	2	4	2	-2	2	99	0.028	0	0		0.0003	0.0006	0.0079	0.0079
Toluene	7	8	0	-8	7.2	92	0.313	0	0		0.0034	0.0245	0.3429	0.3429
Xylene	8	10	0	-10	8.4	106	2.118	0	0		0.0200	0.1678	2.3498	2.3498
EB	8	10	0	-10	8.4	106	0.711	0	0		0.0067	0.0563	0.7888	0.7888
											Total	5.7144	% of total	18%

Appendix L

Human Health Risk Assessment Documentation

APPENDIX L
HUMAN HEALTH RISK ASSESSMENT

This section presents the rationale and technical information used to assess potential human health risks associated with potential exposure to contaminated media at NMCRC-LA. This HHRA follows the following EPA and Cal-EPA guidance, as well as guidance referenced throughout the text:

- *Risk Assessment Guidance for Superfund, Volume I. Human Health Evaluation Manual. Interim Final.* Office of Emergency and Remedial Response. EPA. Washington, D.C. September. U.S. Environmental Protection Agency (EPA). 1989.
- *Recommended Outline for Using U.S. Environmental Protection Agency Region IX Preliminary Remediation Goals in Screening Risk Assessments at Military Facilities.* California Environmental Protection Agency (Cal EPA). Department of Toxic Substances Control. October. 1994.
- *Supplemental Guidance for Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities.* California Environmental Protection Agency (Cal EPA). Office of Scientific Affairs. Corrected and reprinted August 1996.

Appendix L is organized as follows:

- L.1 Procedures used for selecting the HHRA parameters;
- L.2 Exposure assessment, which identifies potential human receptors, potential exposure pathways, and exposure calculation parameters;
- L.3 Toxicity criteria for chemicals of potential concern (COPC) for both carcinogens and non-carcinogens;
- L.4 Estimates of human health cancer risk, toxicological hazard, and child blood-lead levels that could potentially result from exposure to site soil and groundwater contaminants;
- L.5 HHRA results; and
- L.6 Discussion of uncertainties associated with the cancer risk and toxicity estimates

L.1.1 HHRA PARAMETER SELECTION

This section identifies the areas and media of concern, identifies the data used in this HHRA, and describes the COPC selection process.

L.1.1.1 Areas of Concern

Areas of concern are typically selected based on site-specific characteristics, such as the location of potentially exposed populations, the potential for exposure, and the types of chemical contamination. For this HHRA, the NMCRC-LA property area above and surrounding the former gasoline UST (i.e., the area where samples were collected) represents the area of concern. For this HHRA, receptors are considered to have an equal probability of exposure to contaminated media throughout this area of concern.

L.1.1.2 Media of concern

Media of concern at the site are defined as follows (EPA 1989):

- Any currently contaminated medium to which individuals may be exposed or through which analytes may be transported to potential receptors; and
- Any currently uncontaminated medium that may become contaminated in the future because of contaminant transport.

Results of the analytical sampling effort (see Section 4) identified contamination in both soil and groundwater. A screening evaluation (Tier I of the American Society for Testing and Materials [ASTM] risk assessment protocol) was performed in which concentrations of chemicals detected in soil and groundwater were compared to conservative screening criteria (see Section 4). At least one criterion was exceeded for both soil and groundwater, indicating that both soil and groundwater should be included as the media of concern for this HHRA (Tier II).

L.1.1.3 Chemicals of Potential Concern

Chemicals of potential concern are those analytes that are potentially site-related (i.e., released from the gasoline UST), that have data of sufficient quality for use in the quantitative risk assessment, and that are present at concentrations greater than background levels (EPA 1989). Identification of a chemical as a COPC is not indicative of the potential health risk posed by the chemical. Cal/EPA guidance (Cal/EPA 1994) indicates that risk-based screening levels may not

be used to eliminate chemicals as COPCs if at least one chemical exceeds risk-based screening levels, because potential cumulative risk must be evaluated. As indicated in Section 4, several chemicals exceed EPA Region IX PRGs; therefore, risk-based screening levels were not used to eliminate chemicals as COPCs.

Total petroleum hydrocarbon analyses (i.e., TPH-gasoline, TPH-diesel, and TPH-motor oil) were not evaluated in this HHRA as COPCs because they represent concentrations of a group of many analytes. Individual fuel analytes (e.g., benzene, and trimethylbenzene) were analyzed and reported separately and are used in this HHRA. Individual fuel analytes are specifically excluded from CERCLA regulation by CERCLA section 101(14), which excludes “petroleum, including crude oil or any fraction thereof” unless specifically listed or designated under CERCLA. However, analytes that are likely to be associated with petroleum were not excluded from the HHRA.

Soil and groundwater organic analytes (other than TPH) that were detected in at least one sample at the site were included as COPCs in this HHRA. Analytes that were not detected in any samples were not included as COPCs. For inorganic analytes, those metals detected in site samples above background levels were included in this HHRA. Section 4.3 and Appendix J include the results of statistical evaluations used to assess background conditions of metals in soil and groundwater. Table L-1 presents the list of COPCs for soil and groundwater, and identifies the COPCs that are likely to be associated with petroleum contamination.

L.1.1.4 Selection of Data Used in the Risk Assessment

Analytical data for NMCRC-LA were reviewed from the Phase I and Phase II sampling effort of this site investigation and from a previous 1996 investigation (PWC 1996). Limited information was available for the 1996 field program with respect to sampling procedures, laboratory analysis, and data validation protocols; therefore, these 1996 data were not used in this HHRA. Data from the current site investigation are more comprehensive and representative of current site conditions and therefore have been selected for use in the HHRA. Tables L-2 and L-3 present summary statistics for subsurface soil and groundwater analytical results, respectively.

For groundwater samples, unfiltered results were excluded because they were generally somewhat turbid (i.e., containing entrained soil particles). Grab samples of groundwater were especially turbid. Filtered metals samples better represent concentrations of metals dissolved in groundwater, so these results were used in the HHRA.

L.1.2 EXPOSURE ASSESSMENT

An exposure assessment is the estimation of the magnitude, frequency, duration, and route of exposure and may consider past, current, and future exposures (EPA 1989). Components of an exposure assessment consist of the following:

- Characterization of exposure setting and potential receptors,
- Identification of exposure pathways and routes of exposure, and
- Quantification of exposure.

This assessment defines exposure as the contact of humans with a chemical agent (EPA 1989).

L.1.2.1 Characterization of Exposure Setting and Potential Receptors

This step involves characterizing the exposure setting, including the physical characteristics of a site and current and potential future human populations on and/or near the site. Human populations are described with regard to characteristics that might affect exposure to site-related chemicals, including activities and location relative to the site.

The location and setting of NMCRC- LA is described in Section 2. In summary, the site is located in an urban area one mile northeast of downtown Los Angeles. Dodger Stadium and Elysian Park are located north of the site. The site is mostly covered by concrete or asphalt and has a chain link fence around the entire site. Ecological receptors are not present on site because no habitat is present. The City of Los Angeles Fire Department currently uses the site for training; however, there are currently no complete pathways of human exposure to chemicals at the site because of the concrete/asphalt pavement and lack of drinking water wells in this area. Therefore, current scenarios are not evaluated in this HHRA. Land-use restrictions are not presently in place for this site; therefore, future changes in site use (e.g., installation of drinking

water wells, removal of site pavement, and industrial or residential development) could possibly occur, leading to potential exposure of humans to site contaminants. Human populations potentially exposed to site contaminants in the future could include:

- Construction workers,
- Industrial workers, and
- Residents.

L.1.2.2 Identification of Exposure Pathways

An exposure assessment identifies potential pathways by which human populations may be exposed to site-related COPCs (EPA 1989). An exposure pathway consists of the following elements:

- A chemical source and mechanism of release;
- An environmental transport medium for the released chemical;
- A point of potential human contact with the contaminated medium; and
- A route of exposure (e.g., inhalation, ingestion, or dermal absorption) into the receptor.

The absence of any one of these elements would result in an incomplete exposure pathway. For example, individuals driving across the site in an enclosed vehicle may have no point of contact with contaminated soil. Incomplete exposure pathways are not evaluated in this HHRA.

The use of a former gasoline UST and the presence of several drums of unknown waste at the lube rack were the historical potential sources of contamination at the NMCRC-LA site. Contaminated subsurface soils and groundwater below the area of concern are potential current sources of contamination. The potential exposure media consist of soil and groundwater.

As described in Section L.1.2.1, humans do not currently have a point of contact with site contaminants. Changes in site characteristics (e.g., removal of paved covering or installation of drinking water wells) would need to occur for future human receptors to have a point of contact

with site contaminants. Potential scenarios and pathways through which humans might be exposed in the future consist of the following:

- Exposure of construction workers to site contaminants through soil ingestion, dermal contact with soil, and inhalation of particulates and VOCs. This might occur during activities such as excavation of soil during construction of a building foundation.
- Industrial exposure to site contaminants through incidental soil ingestion, dermal contact with soil, and inhalation of particulates and VOCs. This scenario would require removal of the pavement covering the site and industrial development of the site.
- Residential exposure to site contaminants through soil ingestion, dermal contact with soil, and inhalation of particulates and VOCs. This scenario would require removal of the pavement covering the site and residential development of the site.
- Residential exposure to site contaminants in groundwater. This scenario would require installation of groundwater wells for domestic use in the contaminated plume or in a downgradient area potentially impacted by the plume. This could result in exposure to contaminants in groundwater through ingestion, inhalation (i.e., vaporization of volatile contaminants during showering), and dermal exposure (i.e., skin contact during showering).

These scenarios are considered unlikely to occur due to the anticipated future use of the site. However, evaluation of these scenarios for potential impacts to human health was performed to provide a conservative estimate of the potential future risks presented by site contamination. The exposure pathways and routes of exposure for the industrial and residential scenarios are presented in Table L-4. Figures 2-5 and 2-6 show a conceptual site model for current and future scenarios, respectively.

L.1.2.3 Quantification of Exposure

The amount of a chemical that humans take into their bodies following exposure is referred to as chronic daily intake (CDI). The CDI is expressed in units of milligrams of chemical per kilogram of body weight per day (mg/kg-day) and is the standard expression of long-term daily exposure (EPA 1989). Intake depends on the exposure point concentration of chemicals in a medium, such as soil (see Section L.2.3.1). It also depends on the level of exposure specific to the receptor population, including how often and how long the exposure occurs (exposure

frequency and duration), body weight, and contact rate. Depending on the exposure route, contact rate is equivalent to the volume of medium (i.e., soil, groundwater) ingested, air inhaled, or medium contacted dermally each day. The period of time over which exposure is averaged (the averaging time) is used to convert total intake into daily intake. The risk assessment tables presented in Section 7.6 and in this appendix include the CDI values calculated for this assessment.

L.1.2.3.1 Estimation of Exposure Point Concentrations

The exposure concentration is the average chemical concentration a person will contact over a given period of time. The exposure concentration is needed, in addition to assumptions regarding contact level, to calculate intake of a contaminant. This concentration does not reflect the maximum concentration that could be contacted at any one time because, in most situations, it is not reasonable to assume long-term contact with the maximum concentration. Average concentrations are used because of the following:

- Toxicity criteria are based on lifetime average exposures; and
- Average concentration is most representative of the concentration contacted at a site over time, based on the assumption that an exposed individual moves randomly across an exposure area.

Because of the uncertainty associated with estimating the true average concentration at a site, the 95 percent upper confidence limit (UCL) of the arithmetic mean is used as the exposure concentration. Use of the 95% UCL of the arithmetic mean provides reasonable confidence that the true site average will not be underestimated.

EPA's experience shows that most environmental contaminant data sets from soil sampling are lognormally distributed. If the distribution of the data is not determined, EPA recommends calculation of the 95% UCL of the arithmetic mean based on the assumption of lognormal distribution (U.S. EPA 1992c). Therefore, the following equation was used to calculate the 95% UCL for organic analytes, as data distribution was not evaluated for these constituents. The evaluation of background concentrations for inorganic chemicals resulted in evaluation of data

distribution for inorganics (see Section 4.3 and Appendix J). The following equation was also used for inorganic chemicals that had lognormal distributions:

$$UCL_{\log} = e^{(X + 0.5s^2 + sH / (n-1)^{1/2})}$$

Where:

UCL_{\log} = 95% UCL of the arithmetic mean for data sets with a lognormal distribution;

e = base of natural log constant 2.718;

X = mean of transformed data;

s = standard deviation of transformed data;

H = H-statistic; and

n = number of samples.

Results of the background metals analysis identified several inorganic chemicals that had normal data set distributions. For these elements, the 95% upper confidence of the arithmetic mean was calculated based on a normal distribution using the following formula:

$$UCL_{\text{norm}} = X + [1.96(s) / (n)^{1/2}]$$

Where:

UCL_{norm} = 95% UCL of the arithmetic mean;

X = arithmetic mean;

s = standard deviation; and

n = number of samples.

For calculation of the 95% UCL of the arithmetic mean for lognormal or normal distributions, censored data were used at one-half the reported limit of detection. Exceptions to this were:

- If the laboratory reported a chemical as detected but data validators later qualified the value as non-detect. In this instance the data were used at the reported value; and
- If laboratory actions (i.e., dilutions) raised the reporting limits to unusually high levels. This occurred several times; in these instances, the reporting limit was revised to reflect the most commonly reported detection limit in other samples.

L.1.2.3.2 Exposure Assumptions

Chronic daily intake is estimated using the chemical exposure point concentration and exposure variables that describe the level of contact (i.e., duration and frequency of exposure) a receptor may have with the contaminated medium. The level of contact, or contact rate, varies depending on characteristics of the exposed population, such as the age of the person (e.g., adult), the type of activity in which the person is engaged (e.g., industrial activities), and the exposure pathway through which contact occurs (e.g., ingestion exposure).

Exposure assumptions derived from site-specific data are used in risk assessments when available (EPA 1989). When site-specific data are unavailable, standard EPA default values are used based on EPA guidance (EPA 1989, 1991, and 1993). For this HHRA, Cal/EPA default values were also incorporated into calculation of CDI. The exposure assumptions used to calculate chemical intake for industrial workers, construction workers, and hypothetical residents are presented in Table L-5.

L.1.2.3.3 Equations used for Calculation of Chemical Intake

Chemical intakes by potentially exposed human populations (e.g., future industrial and construction workers and residents) were calculated using exposure point concentrations for chemicals in the exposure area and the exposure assumptions described above. CDIs were estimated for each selected exposure pathway for industrial, construction, and residential scenarios. Chronic daily intakes were combined with chemical toxicity values to quantify carcinogenic risks and systemic hazards for each exposure pathway evaluated.

Industrial and Construction Workers

For this HHRA, industrial and construction workers are assumed to be exposed through soil ingestion, dermal contact, and inhalation of particulates and VOCs. The following equations were used to calculate industrial and construction worker chemical intakes for both carcinogenic and noncarcinogenic effects. Values used for the exposure parameters are presented in Table L-5.

The carcinogenic and noncarcinogenic CDI calculation for industrial and construction workers were calculated as follows:

Soil Ingestion:

$$\text{Intake (mg/kg-day)} = ((\text{CS} * \text{IR} * \text{FI} * \text{EF} * \text{ED})/(\text{BW} * \text{AT}))$$

Where:

- CS = chemical concentration in soil (mg of chemical per kg of soil);
- IR = soil ingestion rate (mg of soil ingested per day);
- FI = fraction ingested from contaminated source (unitless);
- EF = exposure frequency (days/year);
- ED = exposure duration (years);
- BW = body weight (kg); and
- AT = averaging time (period over which exposure is averaged, days).

For noncarcinogenic exposure, AT is based on the ED (i.e., 365 days per year x ED), whereas AT for carcinogenic exposure is based on a 70 year lifetime (i.e., 365 days per year x 70 years).

Dermal Exposure to Soil:

$$\text{Intake (mg/kg-day)} = ((\text{CS} * \text{CF} * \text{SA} * \text{AF} * \text{ABS} * \text{EF} * \text{ED})/(\text{BW} * \text{AT}))$$

Where:

- CS = chemical concentration in soil (mg/kg);
- CF = conversion factor (1 x 10⁻⁶ kg/mg);
- SA = skin surface area available for contact (square centimeters per event [cm²/event]);
- AF = soil to skin adherence factor (mg/cm²);
- ABS = absorption factor (unitless);
- EF = exposure frequency (days/year);
- ED = exposure duration (years);
- BW = body weight (kg); and
- AT = averaging time (days).

Inhalation Exposure to VOCs Volatilizing from Soil:

$$\text{Intake} = ((\text{CS} * \text{IhR} * \text{EF} * \text{ED} * (\text{VF} + \text{PEF})) / (\text{AT} * \text{BW}))$$

Where:

- CS = chemical concentration in soil (mg/kg);
- IhR = inhalation rate (m³/day);
- VEF= chemical specific (m³/kg);
- PEF = particulate emission factor (cubic meter [m³]/kg);

EF = exposure frequency (days/year);
ED = exposure duration (years);
BW = body weight (kg); and
AT = averaging time (days).

Residents

For this HHRA, hypothetical residents are assumed to be exposed through soil and groundwater ingestion, dermal contact, and inhalation of particulates and VOCs. Because contact rates vary for children and adults, carcinogenic exposure during the first 30 years of life is calculated using age-adjusted factors. These factors approximate the integrated exposure from birth until age 30 by combining contact rates, body weights, and exposure durations for children and adults.

Age-adjusted factors are obtained using the equations presented below. These age-adjusted factors are used in CDI equations.

Age-Adjusted Factor Equations for Hypothetical Residents:

Soil Ingestion Age-Adjusted Factor:

$$SIF = (((EDc \times IRc)/BWc) + ((EDa \times IRa)/BWa))$$

Where:

SIF = adjusted soil ingestion factor ([mg * year]/[kg * day]);
EDc = child exposure duration (years);
IRc = child soil ingestion rate (mg/day);
BWc = child body weight (kg);
EDa = adult exposure duration (years);
IRa = adult ingestion rate (mg/day); and
BWa = adult body weight (kg)

Groundwater Ingestion Age-Adjusted Factor:

$$GIF = (((EDc \times IRc)/BWc) + ((EDa \times IRa)/BWa))$$

Where:

GIF = adjusted groundwater ingestion factor ([L * year]/[kg * day]);
EDc = child exposure duration (years);
IRc = child groundwater ingestion rate (L/day);
BWc = child body weight (kg);
EDa = adult exposure duration (years);
IRa = adult groundwater ingestion rate (L/day); and

BW_a = adult body weight (kg)

Soil Dermal Contact Age-Adjusted Factor:

SCF = (((ED_c x AF_c * SA_c)/BW_c) + ((ED_a * AF_a* SA_a)/BW_a))

Where:

- SCF = adjusted skin contact factor ([mg * year]/[kg * day]);
- ED_c = child exposure duration (years);
- AF_c = child adherence factor (mg/cm²);
- AF_a = adult adherence factor (mg/cm²);
- BW_c = child body weight (kg);
- ED_a = adult exposure duration (years);
- SA_a = adult skin surface area (cm²/day); and
- BW_a = adult body weight (kg).

Groundwater Dermal Contact Age-Adjusted Factor:

SAF = (((ED_c * SA_c)/BW_c) + ((ED_a* SA_a)/BW_a))

Where:

- SAF = adjusted skin absorption factor ([cm² * year]/kg);
- ED_c = child exposure duration (years);
- SA_c = child skin surface area (cm²);
- BW_c = child body weight (kg);
- ED_a = adult exposure duration (years);
- SA_a = adult skin surface area (cm²); and
- BW_a = adult body weight (kg).

Groundwater and Soil VOCs and Groundwater Particulates Inhalation Age-Adjusted Factor:

IF = (((ED_c x IhR_c)/BW_c) + ((ED_a * IhR_a)/BW_a))

Where:

- IF = adjusted inhalation factor ([m³ * year]/[kg * day]);
- ED_c = child exposure duration (years);
- IhR_c = child inhalation rate (m³/day);
- BW_c = child body weight (kg);
- ED_a = adult exposure duration (years);
- IhR_a = adult inhalation rate (m³/day); and
- BW_a = adult body weight (kg).

Hypothetical Residential Chronic Daily Intake Equations

The following equations are used to calculate hypothetical residential intakes for carcinogenic and noncarcinogenic effects. These equations use the age-adjusted factors above, combined with other exposure assumptions, to calculate CDI. Values used for exposure assumptions are presented in Table L-5.

TABLE L-5. Exposure Assumptions for Residential Intake Calculations

Soil Ingestion:

$$\text{Intake (mg/kg-day)} = ((\text{CS} * \text{SIF} * \text{CF} * \text{FI} * \text{EF})/\text{AT})$$

Where:

- CS = chemical concentration in soil (mg/kg);
- SIF = adjusted soil ingestion factor ([mg * year]/[kg * day]);
- CF = conversion factor (1 x 10⁻⁶ kg/mg);
- FI = fraction ingested from contaminated source (unitless);
- EF = exposure frequency (days/year); and
- AT = averaging time (period over which exposure is averaged, days).

Dermal Exposure to Soil:

$$\text{Intake (mg/kg-day)} = ((\text{CS} * \text{CF} * \text{SCF} * \text{ABS} * \text{EF})/\text{AT})$$

Where:

- CS = chemical concentration in soil (mg/kg);
- CF = conversion factor (1 x 10⁻⁶ kg/mg);
- SCF = adjusted skin contact factor ([mg * year]/[kg * day]);
- ABS = absorption factor (unitless);
- EF = exposure frequency (days/year); and
- AT = averaging time (period over which exposure is averaged, days).

Dermal Exposure to Groundwater:

$$\text{Intake (mg/kg-day)} = ((\text{CW} * \text{CF} * \text{SAF} * \text{DPC} * \text{EF} * \text{ET})/\text{AT})$$

Where:

- CW = chemical concentration in water (mg/l);
- CF = conversion factor (1 x 10⁻³ l/cu.cm);
- SAF = surface area factor ([cm² * year]/kg);
- DPC = dermal permeability constant (cm/hr);
- ET = exposure time (hours/day)
- EF = Exposure frequency (day/year)
- AT = averaging time (period over which exposure is averaged, days).

Inhalation Exposure to Particulates from Soil:

$$\text{Intake} = ((\text{CS} * \text{IF} * \text{EF})/\text{AT} * \text{PEF})$$

Where:

- CS = chemical concentration in soil (mg/kg);
- PEF = particulate emission factor (m³/kg);
- IF = inhalation factor ([m³ * year]/[kg * day]);
- EF = exposure frequency (days/year); and
- AT = averaging time (period over which exposure is averaged, days).

Inhalation Exposure to VOCs Volatilizing from Ground Water:

$$\text{Intake} = ((\text{CW} * \text{IF} * \text{EF} * \text{ET} * \text{InVFW})/\text{AT})$$

Where:

- CW = chemical concentration in soil (mg/kg);
- InVFW = volatilization factor for water (l/m³);
- IF = adjusted inhalation factor ([m³ * year]/[kg * hour]);
- ET = exposure time (hours/day);
- EF = exposure frequency (days/year); and
- AT = averaging time (period over which exposure is averaged, days).

L.1.3 TOXICITY ASSESSMENT

The purpose of the toxicity assessment is to review and summarize the potential for each COPC to potentially cause adverse effects to identified receptors. Adverse effects of chemical agents are generally dependent on the route of exposure (e.g., ingestion), the duration and frequency of exposure, the chemical concentration at the exposure point, and the sensitivity of the exposed individuals. Adverse health effects may occur from chemical exposure ranging in duration from acute (occurring soon after an exposure of a short duration) to subchronic (occurring during or after an intermediate exposure period) or chronic (occurring during or after a long-term exposure).

For most adverse effects caused by chemicals, there is a positive relationship between dose (intake of a chemical via a particular exposure pathway, such as ingestion) and response. Generally, as the dose increases, the type and severity of adverse response also increases. A key facet of any toxicity assessment is to use dose-response information to describe a quantitative relationship between human exposure and potential for adverse health effects. The assessment of dose-response has been completed for ingestion and inhalation exposure routes for many chemicals; however, dose-response assessments are generally lacking for dermal exposure.

Sources of toxicity information include, in order of priority, EPA's on-line Integrated Risk Information System (IRIS) (EPA 1999a); Health Effects Assessment Summary Tables (HEAST) (EPA 1997b); EPA Region IX PRG tables (EPA 1999b); EPA criteria documents; and Agency for Toxic Substances and Disease Registry (ATSDR) toxicological profiles. This hierarchy of

toxicological information sources is based on EPA recommendations (EPA 1989). In addition, Cal/EPA has performed toxicological evaluations for a number of chemicals. Per direction of the Navy, the following chemicals were evaluated using Cal/EPA guidance; cadmium, chromium VI, 1,2-dibromo-3-chloropropane, nickel, benzo(a)pyrene, tetrachloroethane, chrysene, benzo(k)fluoranthene, and lead.

Toxicological information is used to estimate toxicity criteria, which are numerical expressions of the relationship between dose (exposure) and response (adverse health effects). As described below, separate toxicity criteria are developed for assessment of carcinogenic and systemic toxic effects. These toxicity criteria are used in conjunction with estimates of exposure to quantify risks to exposed individuals.

Toxicity criteria for carcinogens are provided as cancer slope factors (CSFs) in units of risk per milligram of chemical per kilogram of body weight per day (mg/kg-day)⁻¹. These factors are based on the assumptions that no threshold for carcinogenic effects exists and that any dose is associated with some finite carcinogenic risk. Carcinogenic toxicity criteria are discussed in greater detail in subsequent sections.

Toxicity criteria for noncarcinogens, or for significant systemic effects caused by carcinogens, are provided (in units of mg/kg-day) as reference doses (RfDs). RfDs may be interpreted as thresholds below which adverse effects are not expected to occur, even in the most sensitive populations. Noncarcinogenic toxicity criteria are discussed in greater detail in the sections that follow.

L.1.3.1 Carcinogens

EPA has developed a system for stratifying evidence supporting classification of chemicals as carcinogens. This classification system characterizes the overall weight of evidence of carcinogenicity based on availability of human, animal, and other supportive data (EPA 1989). Three major factors are considered in characterizing weight of evidence of carcinogenicity: (1) quality of evidence from human studies; (2) quality of evidence from animal studies, and (3)

other supportive data (e.g., studies of mutagenicity). EPA has developed a classification system for characterizing carcinogenicity; this classification system has five categories (EPA 1989):

- **Group A: Human Carcinogen.** This category indicates that there is sufficient evidence from human epidemiological studies to support a causal association between an agent and cancer.
- **Group B: Probable Human Carcinogen.** This category generally indicates that there is at least limited evidence from epidemiological studies of carcinogenicity to humans (Group B1) or, in the absence of adequate data on humans, there is sufficient evidence of carcinogenicity in animals (Group B2).
- **Group C: Possible Human Carcinogen.** This category indicates that there is limited evidence of carcinogenicity in animals and no adequate data on humans.
- **Group D: Not Classified.** This category indicates that evidence for carcinogenicity in both humans and animals is inadequate.
- **Group E: Evidence of Noncarcinogenicity to Humans.** This category indicates that there is evidence for noncarcinogenicity in at least two adequate animal tests in different species or in both epidemiological and animal studies.

EPA has used a variety of specialized models to estimate the upper-bound risk of carcinogenesis for many compounds. Data from animal or epidemiological studies are used to determine CSFs. A CSF relates the increase in an individual's risk of developing cancer over a 70-year lifetime to a unit of exposure (mg/kg-day). Units for CSFs are (mg/kg-day)⁻¹.

Animal studies are usually conducted using relatively high doses to observe possible adverse effects. Since human exposures are generally expected to occur at lower doses, animal data are adjusted using mathematical models to predict cancer risk at low doses. Human epidemiological data must often also be extrapolated to low doses using mathematical models, since human exposure information generally comes from studies of workers who have received much higher exposures than those expected following many environmental releases. Models used assume a linear dose response at low doses, and are generally assumed to provide conservative estimates of carcinogenic potential. Thus, these models provide only rough, but plausible, estimates of upper limits on lifetime risk.

When a CSF is multiplied by the lifetime average daily dose of a potential carcinogen (the CDI), the product is the upper-bound lifetime excess cancer risk associated with exposure at that dose. This calculated risk is an estimate of the increased likelihood of cancer resulting from exposure to a COPC. For example, if the product of the CSF and the lifetime average daily dose is 1×10^{-6} , then the predicted upper-bound lifetime excess cancer risk for the exposed population is one in one million (1:1,000,000). This risk would be in addition to any "background" risk of cancer not related to the chemical exposure. CSFs for COPCs are provided in tables L-6 through L-10.

L.1.3.2 Non-carcinogens

Reference doses are toxicity values developed by EPA for chemicals exhibiting systemic effects after oral and inhalation exposure. RfDs can be derived for substances that are also carcinogens.

The RfDs are estimates of the daily exposure to a chemical that would be without adverse effects, even if the exposure occurred continuously over a lifetime. They are associated with uncertainty spanning an order of magnitude or more. RfDs are presented in units of mg/kg-day for comparison with chemical intake into the body. CDIs that are less than the RfD are not likely to be of concern. CDIs that are greater than the RfD indicate a possibility for adverse effects, at least in sensitive populations. However, whether such exposures actually produce adverse effects will (depending on the chemical) be a function of a number of factors, such as the appropriateness of animal models used in studies extrapolated to humans and the potential for the chemical to cause effects in organs or systems (e.g., reproductive and immune systems) that have not been adequately studied. However, it is generally accepted that the protective assumptions made by EPA in deriving RfDs will, in most cases, mean there may be small risk of systemic health effects for exposures slightly in excess of systemic toxicity criteria, with the probability of adverse effects increasing with increasing exposure. The RfDs for COPCs are provided in risk tables presented in Section L.5.

L.1.4 HUMAN HEALTH RISKS

In this section, potential site-related cancer risks and toxicity hazards are characterized for exposures to COPCs for exposure pathways and routes of exposure presented in Table L-4. In

Section L.4.1, CSFs for COPCs are multiplied with the estimates of CDIs to calculate cancer health risks for each exposure pathway. Total cancer risks, assuming exposure from each pathway and route of exposure, are also discussed. Systemic toxicity hazards associated with exposure to site COPCs are presented in Section L.4.2 where CDIs are divided by RfDs to assess whether associated toxicity is greater than or less than the ratio of one. Total toxicological hazard from exposure through all pathways and routes are also discussed.

L.1.4.1 Cancer Risks

To evaluate cancer risks associated with site COPCs, route-specific CDIs were multiplied by route-specific CSFs. The oral CSF, when available, is used as a proxy for the dermal CSF and the inhalation CSF. This extrapolation is not used for PAHs; EPA guidance (EPA 1989) indicates that it is inappropriate to use the oral CSF to evaluate the risks associated with dermal exposure to carcinogens such as benzo(a)pyrene which cause skin cancer through a direct action at the point of application.

Cancer risks associated with soil exposures were calculated for future construction workers, industrial workers and residents and are presented in Tables L-6, L-7, and L-8, respectively. Tables L-9 and L-10 present the potential cumulative cancer risks for residential exposure to groundwater.

Cancer risk is quantified using the following equation:

CR = CDI x CSF

Where:

- CR = upper-bound estimate of excess lifetime cancer risk to the receptor (unitless estimate of risk);
- CDI = chronic daily intake (mg/kg-day) averaged over 70 years; and
- CSF = cancer slope factor (mg/kg-day)⁻¹.

L.1.4.2 Toxicological Hazard

To evaluate systemic health risks (i.e., liver toxicity, high blood pressure), estimates of CDI are compared to toxicity criteria to assess whether exposure might exceed the threshold established by the RfD. Tables L-6 through L-10 present the EPA RfDs. The ratio of exposure estimate to

toxicity criteria for a single chemical is called a hazard quotient (HQ) and provides a measure of risk for systemic health effects. The ratio is calculated as:

$$\text{HQ} = \text{CDI/RfD}$$

Where:

HQ

=

hazard quotient (unitless estimate of risk);

CDI

=

chronic daily intake mg/kg-day; and

RfD

=

reference dose mg/kg-day.

The HQ assumes that there is a level of exposure (the RfD) below which it is unlikely for even a sensitive population to experience adverse health effects. If the CDI exceeds the RfD, then a potential for noncancer adverse health effects may exist. It is assumed that a small exceedance of the RfD might be associated with minimal hazards and that hazards would increase with an increase in the ratio.

Typically, a risk assessment must evaluate the potential health effects associated with exposure to multiple chemicals. The hazard index (HI) is used to assess the overall potential for systemic effects posed by exposure to multiple chemicals and is equal to the sum of HQs for all of the COCs for a group of receptors (e.g., future residents). When the HI exceeds one, there may be a potential for adverse health effects from exposure to all of the chemicals at the site, and further evaluation is required.

The equation used for the hazard index is as follows:

$$\text{HI} = \sum \text{HQ}$$

Where:

HI

=

Hazard index

HQ

=

Hazard quotient

L.1.5 HUMAN HEALTH RISK ASSESSMENT RESULTS

The following section presents the results of the HHRA for future exposure scenarios for construction workers, industrial workers, and residents that could potentially be exposed to subsurface soils and groundwater at NMCRC-LA. Table L-11 summarizes these results.

Construction Scenario

The cumulative excess lifetime cancer risk for the soil pathway for potential future construction workers was 2×10^{-9} . The majority of this total cancer risk was associated with petroleum-related analytes. The cumulative excess lifetime cancer risk for chemicals that are not related to petroleum was only 9×10^{-11} . EPA generally characterizes incremental cancer risks in the range of 1×10^{-6} to 1×10^{-4} as acceptable. The cancer risks calculated for future construction workers at this site, based on assumption of reasonable maximum exposure, are well below the range generally considered acceptable by EPA. Table L-6 summarizes the results for all routes of exposure.

The future construction scenario did not exceed criteria for systemic toxicity. The cumulative hazard index for all routes of exposure was 0.009 for all chemicals, and 0.0001 for non-petroleum-related chemicals. Both of these hazard indices are well below unity. Table L-6 summarizes these results.

Industrial Scenario

The cumulative excess lifetime cancer risks for the soil pathway for potential future industrial workers was one in one million (1×10^{-6}) for all chemicals, and 4×10^{-8} for non-petroleum-related chemicals. Incremental cancer risks in the range of 1×10^{-6} to 1×10^{-4} are generally characterized as acceptable by the EPA. The cancer risks calculated for future industrial workers at this site, based on assumption of reasonable maximum exposure, fall within the range generally considered acceptable by EPA. When petroleum-related chemicals are excluded the cancer risks calculated for future industrial workers fall well below the range generally considered acceptable by EPA. Table L-7 summarizes the results for all routes of exposure.

The future industrial scenario also did not exceed criteria for systemic toxicity. The cumulative hazard index for all routes of exposure was 0.2 for all chemicals and only 0.003 for non-petroleum-related chemicals. The greatest estimated hazard was via inhalation of VOCs by workers, but the estimated hazard was still over five times lower than the acceptance criteria of less than or equal to 1.0. Table L-7 summarizes these results.

Hypothetical Residential Scenario

Both soil and groundwater pathways were evaluated for the hypothetical residential scenario. The lifetime excess cancer risk from exposure to soil for potential future residents was 4×10^{-6} . The majority of this total cancer risk was associated with petroleum-related analytes. The cumulative excess lifetime cancer risk for chemicals that are not related to petroleum was only 1×10^{-7} . The total estimated risk was within the range generally considered acceptable by EPA, and fell below that range for chemicals that are not petroleum-related.

The hypothetical future residential scenario did not exceed the systemic toxicity criteria of less than or equal to 1.0 using reasonable maximum exposure-point concentrations. The cumulative hazard index for future adult residents was 0.02, and the index for children was 0.2. These hazard indices were about the same for chemicals that are not petroleum-related. Table L-8 summarizes the results.

The cumulative excess lifetime cancer risk for the groundwater pathway for residential exposure was 5×10^{-5} for all chemicals, and 3×10^{-5} for chemicals that are not petroleum-related (Table L-9). Incremental cancer risks in the range of 1×10^{-6} to 1×10^{-4} are generally characterized as acceptable by the EPA. The cancer risks calculated for this site, which are based on conservative exposure scenarios and assumptions of reasonable maximum exposure, fall within the range generally considered acceptable by EPA. Evaluation of the risk assessment results show that benzene and 1,2-DCA are the risk drivers for groundwater by way of the ingestion route of exposure. Benzene concentrations that were reported were only located in the immediate vicinity of the former gasoline UST while 1,2-DCA had a less localized pattern (see Figure 4-12). Using the groundwater modeling results (leachate for the wet case) for benzene 1,2-DCA, and TMBs (concentrations estimated at the property boundary) as the EPCs for groundwater results in a decreased estimate of excess cancer cases from 5×10^{-5} to 1×10^{-5} and a small decrease in systemic hazard. Table L-10 presents these results.

The cumulative hazard index (HI) values for adults and children were 2 and 6, respectively. Approximately half of each hazard index is associated with chemicals that are not petroleum-

related. These values exceed unity and indicate that there may be a low potential for adverse systemic effects from ingestion of contaminated groundwater at the source area. It is noted that these HI are based on conservative estimates of reasonable maximum exposure and conservatively assume additive health effects from exposure to COPCs. Table L-9 presents the results for groundwater exposure.

The exposure point concentration for lead was lower than the 4 ug/l default value used in the Integrated Exposure Uptake Biokinetic model, and lead concentrations in soil were within background concentrations. Lead concentrations in the media of concern indicate that blood-lead levels would meet the 10 ug/deciliter (dl) criteria; therefore, modeling of blood-lead levels was not performed.

Summary

Table L-11 summarizes the results for each scenario.

L.1.6 UNCERTAINTIES

Risk calculations are based on standard EPA default exposure assumptions, toxicology literature, and estimates of chemical concentrations. There are uncertainties associated with all of these sources, and hence, there is uncertainty in estimates of risk. To appropriately interpret and use risk estimates, uncertainties must be recognized and understood. Sources of uncertainty include the following:

- Estimates of chemical concentrations;
- Exposure assumptions;
- Lack of bioavailability data for COPCs in soil from the study area; and
- Toxicity criteria.

It is likely that the receptors, exposure pathways, and exposure assumptions used in this HHRA result in an overestimation of exposure and, therefore, risk. These sources of uncertainty are described in greater detail below.

L.1.6.1 Estimates of Chemical Concentrations and the Exposure Point Concentration

Sample collection from the NMCRC-LA site were biased towards areas of contamination.

Samples were collected from areas suspected of being in the most contaminated portion of the site, as well as from selected areas around the vicinity of the lube rack and former UST locations. This significantly increases the probability of overestimating the exposure point concentrations.

Analytical results from the Phase I and Phase II sampling effort identified subsurface soils in the 15 to 25 feet bgs depths as the strata of greatest contamination. Residents are not likely to be chronically exposed to subsurface soils at these depths.

Use of the lesser of the maximum or 95% UCL of the mean concentration as the exposure point concentration for future scenarios assumes that no biodegradation of hydrocarbon analytes would occur. However, based on fate and transport modeling (Section 6), biodegradation is likely occurring. The assumption of no biodegradation results in an overestimation of the analyte concentrations that would likely exist in the future and adds to an overestimation of risk and hazard.

L.1.6.2 Receptors and Exposure Assumptions

The site is currently capped by concrete and asphalt and is being used by the Los Angeles City Fire Department for training purposes. It is unlikely that site use will change significantly in the near future. It is also unlikely that this site would be zoned as residential in the near future.

There are currently no drinking water wells on the property, but for the future risk exposure scenario for this HHRA, groundwater consumption was assumed to occur onsite. It should be noted that general chemistry results indicate that groundwater in this area is not very suitable for drinking water purposes. For example, chloride concentrations in many site groundwater samples exceed the secondary recommended MCL (SMCL) of 250 mg/L, the SMCL for sulfate of 250 mg/L and the SMCL for total dissolved solids (TDS) of 500 mg/L (Cal/EPA 1998).

Groundwater consumption from an offsite well that could possibly be installed just outside the NMCRC-LA property boundary in the future was also assessed in this HHRA using predicted concentrations from groundwater modeling (Section 6). The results are likely conservative, as discussed in Section 6.0.

The assumptions used in this HHRA to evaluate exposure were based on standard EPA and Cal-EPA default reasonable maximum exposure values. These values may not be representative of the future site conditions. In addition to the uncertainties associated with the use of standard default exposure parameters, there is likely additional overestimation resulting from the combined use of reasonable maximum exposure for all routes of exposure (i.e., soil ingestion, dermal exposure, and particulate inhalation). It is highly unlikely that a person would be maximally exposed through all routes of exposure.

L.1.6.3 Uncertainties Associated with Toxicity Assessments

There are many uncertainties intrinsic to the study of toxicology. Important among these are the following:

- Use of dose-response information from high-dose studies to predict adverse health effects at low doses.
- Applicability of experimental animal studies to predict accurate health effects in humans.
- Use of dose-response information from short-term exposure studies to predict adverse health effects of long-term exposures.
- Use of toxicity values derived from homogeneous animal populations or healthy human populations to predict adverse effects in the general population, which is likely to contain sensitive individuals.
- Quality of the study (i.e., design and conduct).
- Selection criteria for the appropriate study used in the development of toxicity values.

The procedures used to derive toxicological and carcinogenic values are intended to protect public health. Calculated RfDs and CSFs are likely overly protective and may result in an overestimation of risk to human health.

Table L-1
COPC List For NMCRC-LA, 1999

CAS Number	Analyte Name	EPA Weight-of-Evidence Classification ¹	Soil	Groundwater
56-55-3	Benz(a)anthracene	B2	X	
205-99-2	Benzo(b)fluoranthene	B2	X	
191-24-2	Benzo(g,h,i)perylene	D	X	
218-01-9	Chrysene	B2	X	
84-74-2	Di-n-butylphthalate	D		X
206-44-0	Fluoranthene	B2	X	
193-39-5	Indeno(1,2,3-cd)pyrene	B2	X	
91-57-6	2-methylnaphthalene	none	X	X
91-20-3	Naphthalene	C	X	X
85-01-8	Phenanthrene	D	X	
129-00-0	Pyrene	D	X	
95-63-6	1,2,4-Trimethylbenzene	none	X	X
107-06-2	1,2-Dichloroethane	B2	X	X
108-67-8	1,3,5-Trimethylbenzene	none	X	X
78-93-3	2-Butanone (MEK)	D	X	
67-64-1	Acetone	D	X	X
71-43-2	Benzene	A	X	X
67-66-3	Chloroform	B2		X
100-41-4	Ethylbenzene	D	X	X
98-82-8	Isopropylbenzene	none	X	X
1330-20-7	M/P-Xylene	D	X	X
75-09-2	Methylene Chloride	B2	X	
104-51-8	N-butylbenzene	none	X	
103-65-1	N-propylbenzene	none	X	X
1330-20-7	O-xylene	D	X	X
99-87-6	P-isopropyltoluene	none	X	X
135-98-8	Sec-butylbenzene	none	X	X
98-06-6	Tert-butylbenzene	none	X	X
127-18-4	Tetrachloroethene	none	X	X
108-88-3	Toluene	D	X	X
1336-36-3	Aroclor 1260	B2	X	
7440-36-0	Antimony	N/A		X
7440-39-3	Barium	D		X
7440-47-3	Chromium	D	X	
7440-48-4	Cobalt	D	X	X
7439-92-1	Lead	B2		X
7439-98-7	Molybdenum	D	X	X
744-02-0	Nickel	N/A	X	X
7440-62-2	Vanadium	D	X	
7440-66-6	Zinc	D		X

Notes:
CAS = Chemical Abstract Number
COPCs = Chemicals of potential concern
NMCRC-LA = Naval and Marine Corps Reserve Center-Los Angeles
EPA = Environmental Protection Agency
N/A = Not Available
1 = Weight of evidence classifications rationale presented in Section L-3, Appendix I

Table L-2
Summary Statistics for COPCs in Subsurface Soils
NMCRC-LA, 1999-2000

Analyte	Number of Samples	Detection Frequency	Minimum Reported Concentration	Maximum Reported Concentration	Arithmetic Mean	Standard Deviation ^(b)	95% UCL ^(c)	Exposure Point Concentration ^(d)
SVOCs (µg/kg)								
Benz(a)anthracene	50	2%	140	140	5.66	0.11	293.77	140.00
Benzo(a)pyrene	50	4%	56	180	5.63	0.24	298.20	180.00
Benzo(b)fluoranthene	50	4%	57	290	5.67	0.28	313.75	290.00
Benzo(g,h,i)perylene	50	2%	82	82	5.82	0.36	377.68	82.00
Chrysene	50	4%	85	220	6.01	0.43	472.05	220.00
Fluoranthene	50	4%	110	300	5.66	0.14	295.06	295.06
Indeno(1,2,3-cd)pyrene	50	2%	82	82	5.82	0.36	377.68	82.00
2-Methylnaphthalene	50	16%	265	3100	5.83	0.45	401.48	401.48
Naphthalene	50	18%	70	7300	5.88	0.69	502.28	502.28
Phenanthrene	50	4%	72	200	5.64	0.21	296.21	200.00
Pyrene	50	4%	150	370	5.83	0.32	376.54	370.00
VOCs (µg/kg)								
1,2,4-Trimethylbenzene	50	28%	1	40500	2.82	3.37	8018.89	8018.89
1,2-Dichloroethane	50	18%	1	12	1.25	0.93	6.12	6.12
1,3,5-Trimethylbenzene	50	22%	1	27200	2.43	2.83	930.16	930.16
2-Butanone (MEK)	50	30%	4	129	3.55	1.14	78.71	78.71
Acetone	50	40%	7	290	4.28	0.82	113.40	113.40
Benzene	50	16%	1	698	1.47	1.22	10.97	10.97
Carbon disulfide	50	10%	1	36	1.32	1.04	7.43	7.43
Ethylbenzene	50	32%	1	9810	2.29	2.60	426.72	426.72
Isopropylbenzene (cumene)	50	28%	2	1580	2.00	1.93	62.78	62.78
m,p-Xylene	50	20%	1	35000	2.24	2.83	774.28	774.28
Methylene Chloride	50	10%	3	54	2.11	1.43	27.97	27.97
Naphthalene	50	28%	3	4760	2.33	2.51	345.21	345.21
N-Butylbenzene	50	2%	3	4	1.10	0.15	3.11	3.11
N-Propylbenzene	50	10%	3	960	1.32	1.05	7.56	7.56
o-Xylene	50	14%	3	12600	1.96	2.30	138.51	138.51
p-Isopropyltoluene	50	22%	3	891	1.92	1.73	39.05	39.05
Sec-Butylbenzene	50	24%	1	831	1.77	1.68	30.40	30.40
Tert-Butylbenzene	50	2%	3	2370	1.25	0.96	6.30	6.30
Tetrachloroethene	50	2%		1	1.07	0.21	3.56	1.00
Toluene	50	14%	3	5620	1.75	1.80	37.80	37.80
PCBs (µg/kg)								
Aroclor 1260	50	8%	14	21	3.07	0.35	24.06	21.00
Metals (mg/kg)								
Chromium	19	100%	5	37	21.93(e)	5.34(e)	23.11(e)	23.11
Cobalt	19	100%	3	24	10.91(e)	3.21(e)	17.23(e)	23.80
Molybdenum	19	84%	0	6	0.21	0.95	1.16	1.16
Nickel	19	100%	6	39	25.98(e)	7.11(e)	27.55(e)	27.55
Vanadium	19	100%	8	79	52.12(e)	13.72(e)	79.08(e)	79.30

(a) = Includes field QC duplicate samples
(b)= Standard deviation of (natural) log transformed data
(c)= 95% upper confidence limit of the arithmetic mean for lognormal distribution of data
(d)= Exposure point concentration is the lower of either the maximum or 95% UCL of mean value
(e)= Calculated results based on a normal distribution per background statistical results
NMCRC-LA = Naval and Marine Corps Reserve Center - Los Angeles
COPC = Chemical of potential concern
PCBs = Polychlorinated biphenyls
SVOCs = Semivolatile organic compounds
VOCs = Volatile Organic Compounds
UCL = Upper Confidence Limit
mg/kg = milligram per kilogram
µg/kg = microgram per kilogram

Table L-3
Summary Statistics for COPCs in Groundwater
NMCRC-LA, 1999-2000

Analyte	Number of Samples ^(a)	Detection Frequency	Minimum Detected Concentration (µg/l)	Maximum Detected Concentration (µg/l)	Arithmetic Mean (µg/l)	Lognormal Standard Deviation (µg/l)	95% UCL	Exposure Point Concentration (µg/l)
SVOCs								
DI-N-BUTYL PHTHALATE	16	6.3%	19	19	6.59	0.52	8.71	8.71
2-METHYLNAPHTHALENE	16	25.0%	5	26	8.44	0.54	11.07	11.07
NAPHTHALENE	16	18.8%	19	76	14.94	0.91	23.75	23.75
VOCs								
1,2,4-TRIMETHYLBENZENE	19	47.4%	1	1130	65.50	1.60	74.22	74.22
1,2-DICHLOROETHANE	19	68.4%	1	28	7.66	0.96	13.32	13.32
1,3,5-TRIMETHYLBENZENE	19	36.8%	3	320	20.58	1.13	18.23	18.23
BENZENE	19	42.1%	1	588	35.95	1.37	37.79	37.79
CARBON DISULFIDE	19	5.3%	1	1	2.55	0.27	2.88	1.00
CHLOROFORM	19	36.8%	1	10	2.68	0.73	4.03	4.03
ETHYLBENZENE	19	26.3%	2	711	40.32	1.31	22.59	22.59
ISOPROPYLBENZENE	19	52.6%	1	54	5.24	0.98	7.35	7.35
M/P-XYLENE	19	15.8%	3	1590	86.79	1.47	40.98	40.98
NAPHTHALENE	19	36.8%	1	120	10.06	1.11	13.12	13.12
N-PROPYLBENZENE	19	26.3%	1	304	19.16	1.26	18.23	18.23
O-XYLENE	19	5.3%	528	528	30.29	1.23	17.41	17.41
P-ISOPROPYLTOLUENE	19	21.1%	0	10	2.81	0.61	3.87	3.87
SEC-BUTYLBENZENE	19	36.8%	1	12	2.80	0.72	4.09	4.09
TERT-BUTYLBENZENE	19	26.3%	1	1	2.01	0.65	2.96	1.00
TETRACHLOROETHENE	19	15.8%	1	2	2.37	0.22	2.61	2.00
TOLUENE	19	15.8%	1	313	18.89	1.27	15.97	15.97
METALS (Filtered)								
Barium	19	100.0%	15	445	97.62	1.06	176.94	176.94
Cobalt	19	26.0%	1	30	5.52	0.93	8.86	8.86
Lead	19	11.0%	7	17	3.87	0.50	1.44	1.44
Nickel	19	74.0%	3	41	9.93	0.89	16.53	16.53
Molybdenum	19	95.0%	17	344	53.25	0.92	92.42	92.42
Antimony	19	37.0%	3	11	5.13	0.28	5.80	5.80
Zinc	19	95.0%	7	25	14.05	0.55	19.01	19.01

Notes:

(a) = Includes field QC duplicate samples

95% UCL= 95% upper confidence limit of the arithmetic mean

Sample results qualified as "U", not-detected were used in the statistical calculations at 1/2 the reported limit of detection

Sample results qualified as "UJ", estimated non-detected, were used in the statistical calculations at the reported limit of detection

NMCRC-LA = Naval and Marine Corps Reserve Center - Los Angeles

UCL = Upper Confidence Limit

VOCs = Volatile Organic Compounds

SVOCs = Semivolatile organic compounds

COPC = Chemical of potential concern

mg/L = milligram per liter

µg/L = microgram per liter

Table L-4
Exposure Scenarios

Future Scenario	Exposure Pathway	Exposure Route
Construction	Subsurface Soils	Ingestion Inhalation (dust/vapors) Dermal Contact
Industrial	Subsurface Soils	Ingestion Inhalation (dust/vapors) Dermal Contact
Residential	Subsurface Soils	Ingestion Inhalation (dust/vapors) Dermal Contact
Residential	Ground Water	Ingestion Inhalation (vapors) Dermal Absorption via Shower

NMCRC-LA = Naval and Marine Corps Reserve Center, Los Angeles

TABLE L-5
Exposure Assumptions for Future
Construction and Industrial Workers And Residents
NMCRC-LA

Ingestion of Soils, Inhalation of particulates, and Dermal Exposure				
IR - Ingestion Rate used for Ingestion of Soil				
Ingestion Rate for Industrial/Construction Workers	50	mg/day	Recommended by EPA Region IX	EPA 1999
Ingestion Rate for Residents - Adults	100	mg/day	Recommended by EPA Region IX	EPA 1999
Ingestion Rate for Residents - Children	200	mg/day	Recommended by EPA Region IX	EPA 1999
SIF - Soil Ingestion Factor Adjusted for Residents - Adults and Children	114	mg-yr/kg-d	Recommended by EPA Region IX	EPA 1999
IR - Ingestion Rate used for Ingestion of Groundwater				
Ingestion Rate for Residents - Adults	2	l/day	Recommended by EPA Region IX	EPA 1999
Ingestion Rate for Residents - Children	1	l/day		EPA 1997
WIF - Groundwater Ingestion Factor Adjusted for Residents - Adults and Children	1.09	l-yr/kg-d		
IhR - Inhalation Rate used for Inhalation of Particulates/Vapors				
Inhalation Rate for Industrial/Construction Workers	20	m3/day	Recommended by EPA Region IX	EPA 1999
Inhalation Rate for Residents - Adults	20	m3/day	Recommended by EPA Region IX	EPA 1999
Inhalation Rate for Residents - Children	10	m3/day	Recommended by EPA Region IX	EPA 1999
IF - Inhalation Factor Adjusted for Residents - Adults and Children	11	m3-yr/kg-d	Recommended by EPA Region IX	EPA 1999
Hourly Inhalation Rate for Residents - Adults and Children Showering	0.6	m3/hour	Recommended by EPA	EPA 1989
IhVFS - Soil Volatilization Factor used for Inhalation of Volatile Organics ^(a)	Chemical Specific m3/kg			
IhVFW - Water Volatilization Factor used for Inhalation	0.5	l/m3	Recommended by EPA Region IX	EPA 1999
SCF - Skin Contact Factor for Residents - Adults and Children	361	mg-yr/kg-d	Recommended by EPA Region IX	EPA 1999
SA - Surface Area used for Dermal Exposure				
Skin Surface Area for Industrial/Construction Workers	3 300	sq cm/day	Recommended by EPA Region IX	EPA 1999
Skin Surface Area for Residents - Child	2 800	sq cm/day	Recommended by EPA Region IX	EPA 1999
Skin Surface Area for Residents - Adult	5 700	sq cm/day	Recommended by EPA Region IX	EPA 1999
SAF - Surface Area for Dermal Exposure Adjusted for Residents	3,074	sq cm-yr/kg-day		
surface area for showering	23 000	sq cm	Recommended by EPA Region IX	EPA 1999
AF- Adherence Factor used for Dermal Exposure				
Soil-to-Skin Adherence Factor (industrial/construction worker and child)	0.2	mg/sq cm	Recommended by EPA Region IX	EPA 1999
Soil-to-Skin Adherence Factor (adult)	0.07	mg/sq cm	Recommended by EPA Region IX	EPA 1999
ABS - Soil Dermal Absorption Values				
SVOCs	13%		Recommended by EPA Region IX	EPA 1999
VOCs	10%		Recommended by EPA Region IX	EPA 1999
PCBs	14%		Recommended by EPA Region IX	EPA 1999
Metals ^(b)	1%			
DPC -Dermal Permeability Constant				
Organics	Chemical Specific cm/hr			
Inorganics	1.00E-03	cm/hr		
CF - Conversion Factor				
Conversion Factor	1.00E-06	kg/mg	Recommended by EPA	EPA 1989
Conversion Factor	1.00E-03	l/cu cm		
EF - Exposure Frequency				
Exposure Frequency for Construction Workers	14	days/year	Estimated	
Exposure Frequency for Industrial Workers	250	days/year	Recommended by EPA Region IX	EPA 1999
Exposure Frequency for Residents - Adults and Children	350	days/year	Recommended by EPA Region IX	EPA 1999
ED - Exposure Duration				
Exposure Duration for Construction Workers	1	year	Estimated	
Exposure Duration for Industrial/Commercial Workers	25	years	Recommended by EPA	EPA 1993
Exposure Duration for Residents - Adults	24	years	Recommended by EPA Region IX	EPA 1999
Exposure Duration for Residents - Children	6	years	Recommended by EPA Region IX	EPA 1999
BW - Body Weight				
Body Weight for Industrial/Construction Workers	70	kg	Recommended by EPA Region IX	EPA 1999
Body Weight for Residents - Adults	70	kg	Recommended by EPA Region IX	EPA 1999
Body Weight for Residents - Children	15	kg	Recommended by EPA Region IX	EPA 1999
AT - Averaging Time ^(c)				
Carcinogens	25 550	days	Recommended by EPA	EPA 1989
Noncarcinogens - Construction Workers	365	days	Recommended by EPA	EPA 1989
Noncarcinogens - Industrial Workers	9,125	days	Recommended by EPA	EPA 1989
Noncarcinogens - Residents	10,950	days		
Noncarcinogens - Residents - Adults	8 760	days		
Noncarcinogens - Residents - Children	2 190	days	Recommended by EPA	EPA 1989
PEF - Particulate Emission Factor				
Particulate Emission Factor - Construction Activities	6.67E+06	cu m/kg	CDM Federal Programs	
Particulate Emission Factor - Typical Activities	1.32E+09	cu m/kg	Recommended by EPA Region IX	EPA 1999
FI - Fraction of Soil Ingested from Site				
Fraction of Soil Ingested from Site - All Receptors	100%		DTSC	
Exposure time for showering	0.583	h/d	Recommended by EPA	EPA 1997

Notes:

(a)= Chemicals having a Henry's Law Constant greater than 10⁻⁵ and a molecular weight less than 200 grams per mole

(b)= All COPC metals

(c)= AT, carcinogenic = 70 years * 365 days/year = 25550 days AT, noncarcinogenic = Exposure Duration * 365 days/year

NMCRC-LA = Naval and Marine Corps Reserve Center - Los Angeles

DTSC = Department of Toxic Substances Control

mg = milligrams, kg=kilogram cm=centimeter, mg-yr = milligram-year, kg-d = kilogram-day m3= cubic meters = sq cm = square centimeter

sq.cm-yr = square centimeter-year cu cm=cubic centimeter h/d= hours per day

Table L-6
Future Construction Worker Scenario
Cancer Risks and Toxicity Hazard from Subsurface Soil Exposure
NMCRC-LA

CHEMICAL	Exposure Point Concentration (mg/kg)	CDI (cancer) (mg/kg-day)	California CSF (Chronic) (mg/kg-day)-1	EPA - CSF (Chronic) (mg/kg-day)-1	Cancer Risk based on EPA & CA CSF	CSF Used	CDI (noncancer) (mg/kg-day)	EPA - RfD (mg/kg-day)	Hazard based on EPA RfD
SOIL INGESTION ROUTE									
SVOCs									
* BENZ(A)ANTHRACENE	1.40E-01	5.48E-11	9.00E-01	7.30E-01	4.00E-11	EPA	3.84E-09	2.00E-02	a 1.92E-07
* Benzo(a)pyrene	1.80E-01	7.05E-11	9.00E+00	7.30E+00	6.34E-10	CA	4.93E-09	2.00E-02	a 2.47E-07
* BENZO(B)FLUORANTHENE	2.90E-01	1.14E-10	9.00E-01	7.30E-01	8.29E-11	EPA	7.95E-09	2.00E-02	a 3.97E-07
* BENZO(G,H,I)PERYLENE	8.20E-02	3.21E-11	NC	NC	NC		2.25E-09	2.00E-02	a 1.12E-07
* CHRYSENE	2.20E-01	8.61E-11	9.00E-02	7.30E-03	7.75E-12	CA	6.03E-09	2.00E-02	a 3.01E-07
* FLUORANTHENE	2.95E-01	1.15E-10	NC	NC	NC		8.08E-09	2.00E-02	a 4.04E-07
* INDENO(1,2,3-CD)PYRENE	8.20E-02	3.21E-11	9.00E-01	7.30E-01	2.34E-11	EPA	2.25E-09	2.00E-02	a 1.12E-07
* 2-METHYLNAPHTHALENE	4.01E-01	1.57E-10	NC	NC	NC		1.10E-08	2.00E-02	a 5.50E-07
* NAPHTHALENE	5.02E-01	1.97E-10	NC	NC	NC		1.38E-08	2.00E-02	a 6.88E-07
* PHENANTHRENE	2.00E-01	7.83E-11	NC	NC	NC		5.48E-09	2.00E-02	a 2.74E-07
* PYRENE	3.70E-01	1.45E-10	NC	NC	NC		1.01E-08	3.00E-02	3.62E-06
CHEMICAL CLASS-SPECIFIC RISK =									
VOCs									
* 1,2,4-TRIMETHYLBENZENE	8.02E+00	3.14E-09	none	none	none		2.20E-07	1.00E-02	a 3.14E-07
1,2-DICHLOROETHANE	6.12E-03	2.39E-12	7.00E-02	9.10E-02	2.18E-13	EPA	1.68E-10	3.00E-02	b 7.98E-11
* 1,3,5-TRIMETHYLBENZENE	9.30E-01	3.64E-10	none	none	none		2.55E-08	1.00E-02	a 3.64E-08
2-BUTANONE (MEK)	7.87E-02	3.08E-11	NC	NC	NC		2.16E-09	6.00E-01	5.13E-11
ACETONE	1.13E-01	4.44E-11	NC	NC	NC		3.11E-09	1.00E-01	4.44E-10
* BENZENE	1.10E-02	4.30E-12	1.00E-02	1.50E-02	6.44E-14	EPA	3.01E-10	3.00E-03	b 1.43E-09
Carbon disulfide	7.43E-03	2.91E-12	none	none	none		2.04E-10	1.00E-01	2.91E-11
* ETHYLBENZENE	4.27E-01	1.67E-10	NC	NC	NC		1.17E-08	1.00E-01	1.67E-09
* ISOPROPYLBENZENE	6.28E-02	2.46E-11	none	none	none		1.72E-09	1.00E-02	a 2.46E-09
* M/P-XYLENE	7.74E-01	3.03E-10	NC	NC	NC		2.12E-08	2.00E+00	1.52E-10
METHYLENE CHLORIDE	2.80E-02	1.09E-11	3.50E-03	7.50E-03	8.21E-14	EPA	7.66E-10	6.00E-02	1.82E-10
* NAPHTHALENE	3.45E-01	1.35E-10	NC	NC	NC		9.46E-09	2.00E-02	6.76E-09
* N-BUTYLBENZENE	3.11E-03	1.22E-12	none	none	none		8.53E-11	1.00E-02	a 1.22E-10
* N-PROPYLBENZENE	7.56E-03	2.96E-12	none	none	none		2.07E-10	1.00E-02	a 2.96E-10
* O-XYLENE	1.39E-01	5.42E-11	NC	NC	NC		3.79E-09	2.00E+00	2.71E-11
* P-ISOPROPYLTOLUENE	3.91E-02	1.53E-11	none	none	none		1.07E-09	2.00E-01	a 7.64E-11
* SEC-BUTYLBENZENE	3.04E-02	1.19E-11	none	none	none		8.33E-10	1.00E-02	a 1.19E-09
* TERT-BUTYLBENZENE	6.30E-03	2.47E-12	none	none	none		1.73E-10	1.00E-02	a 2.47E-10
TETRACHLOROETHENE	1.00E-03	3.91E-13	none	none	none		2.74E-11	1.00E-02	3.91E-11
* TOLUENE	3.78E-02	1.48E-11	NC	NC	NC		1.04E-09	2.00E-01	7.40E-11
CHEMICAL CLASS-SPECIFIC RISK =									
PCBs									
AROCLOR 1260	2.10E-02	8.22E-12	7.70E+00	2.00E+00	1.64E-11	EPA	5.75E-10	2.00E-05	b 4.11E-07
CHEMICAL CLASS-SPECIFIC RISK =									
METALS									
Chromium	2.31E+01	9.05E-09	NA	NA	NA		6.33E-07	1.50E+00	b,e 6.03E-09
Cobalt	2.38E+01	9.32E-09	NA	NA	NA		6.52E-07	6.00E-02	e 1.55E-07
Molybdenum	1.16E+00	4.54E-10	none	none	none		3.18E-08	5.00E-03	9.08E-08
Nickel	2.76E+01	1.08E-08	NA	NA	NA		7.55E-07	2.00E-02	c none
Vanadium	7.93E+01	3.10E-08	NA	NA	NA		2.17E-06	7.00E-03	c 4.43E-06
CHEMICAL CLASS-SPECIFIC RISK =									
PATHWAY-SPECIFIC RISK =									

TABLE L-6
Future Construction Worker Scenario
Cancer Risks and Toxicity Hazard from Subsurface Soil Exposure
NMCRC-LA

CHEMICAL	Exposure Point Concentration (mg/kg)	CDI (cancer) (mg/kg-day)	California CSF (Chronic) (mg/kg-day)-1	EPA - CSF (Chronic) (mg/kg-day)-1	Cancer Risk based on EPA & CA CSF	CSF Used	CDI (noncancer) (mg/kg-day)	EPA - RfD (mg/kg-day)	Hazard based on EPA RfD
PATHWAY-SPECIFIC RISK (Petroleum) =									
PATHWAY-SPECIFIC RISK (CERCLA-only) =									
7.88E-10									
1.67E-11									
3.98E-06									
5.10E-06									
INHALATION ROUTE - Particulates / Vapors ^d									
SVOCs ^c									
* BENZO(A)ANTHRACENE	1.40E-01	3.29E-12	9.00E-01	7.30E-01	2.40E-12	EPA	2.30E-10	2.00E-02	1.15E-08
* Benzo(a)pyrene	1.80E-01	4.22E-12	9.00E+00	7.30E+00	3.80E-11	CA	2.96E-10	2.00E-02	1.48E-08
* BENZO(B)FLUORANTHENE	2.90E-01	6.81E-12	9.00E-01	7.30E-01	4.97E-12	EPA	4.76E-10	2.00E-02	2.38E-08
* BENZO(G,H,I)PERYLENE	8.20E-02	1.92E-12	NC	NC	NC		1.35E-10	2.00E-02	6.74E-09
* CHRYSENE	2.20E-01	5.16E-12	9.00E-02	7.30E-03	4.65E-13	CA	3.61E-10	2.00E-02	1.81E-08
* FLUORANTHENE	2.95E-01	6.93E-12	NC	NC	NC		4.85E-10	2.00E-02	2.42E-08
* INDENO(1,2,3-CD)PYRENE	8.20E-02	1.92E-12	9.00E-01	7.30E-01	1.41E-12	EPA	1.35E-10	2.00E-02	6.74E-09
* 2-METHYLNAPHTHALENE	4.01E-01	9.42E-12	NC	NC	NC		6.60E-10	2.00E-02	3.30E-08
* NAPHTHALENE	5.02E-01	1.18E-11	NC	NC	NC		8.25E-10	2.00E-02	4.13E-08
* PHENANTHRENE	2.00E-01	4.69E-12	NC	NC	NC		3.29E-10	2.00E-02	1.64E-08
* PYRENE	3.70E-01	8.68E-12	NC	NC	NC		6.08E-10	3.00E-02	2.03E-08
CHEMICAL CLASS-SPECIFIC RISK =									
VOCs ^a									
* 1,2,4-TRIMETHYLBENZENE	8.02E+00	1.11E-06	none	none	none		7.74E-05	1.00E-02	7.74E-03
1,2-DICHLOROETHANE	6.12E-03	2.54E-10	7.00E-02	9.10E-02	2.31E-11	EPA	1.78E-08	3.00E-02	5.94E-07
* 1,3,5-TRIMETHYLBENZENE	9.30E-01	1.56E-07	none	none	none		1.09E-05	1.00E-02	1.09E-03
2-BUTANONE (MEK)	7.87E-02	6.49E-10	NC	NC	NC		4.54E-08	6.00E-01	7.57E-08
ACETONE	1.13E-01	2.29E-09	NC	NC	NC		1.60E-07	1.00E-01	1.60E-06
* BENZENE	1.10E-02	1.79E-09	1.00E-02	1.50E-02	2.69E-11	EPA	1.25E-07	3.00E-03	4.18E-05
Carbon disulfide	7.43E-03	1.25E-09	none	none	none		8.78E-08	1.00E-01	8.78E-07
* ETHYLBENZENE	4.27E-01	7.20E-08	NC	NC	NC		5.04E-06	1.00E-01	5.04E-05
* ISOPROPYLBENZENE	6.28E-02	5.59E-10	none	none	none		3.91E-08	1.00E-02	3.91E-06
* M/P-XYLENE	7.74E-01	1.36E-08	NC	NC	NC		9.51E-07	2.00E+00	4.75E-07
METHYLENE CHLORIDE	2.80E-02	2.75E-09	3.50E-03	7.50E-03	2.06E-11	EPA	1.92E-07	6.00E-02	3.21E-06
* NAPHTHALENE	3.45E-01	1.92E-09	NC	NC	NC		1.34E-07	2.00E-02	6.72E-06
* N-BUTYLBENZENE	3.11E-03	3.25E-12	none	none	none		2.27E-10	1.00E-02	2.27E-08
* N-PROPYLBENZENE	7.56E-03	7.88E-12	none	none	none		5.52E-10	1.00E-02	5.52E-08
* O-XYLENE	1.39E-01	2.43E-09	NC	NC	NC		1.70E-07	2.00E+00	8.50E-08
* P-ISOPROPYLTOLUENE	3.91E-02	9.64E-11	none	none	none		6.75E-09	2.00E-01	3.38E-08
* SEC-BUTYLBENZENE	3.04E-02	6.43E-09	none	none	none		4.50E-07	1.00E-02	4.50E-05
* TERT-BUTYLBENZENE	6.30E-03	1.22E-09	none	none	none		8.56E-08	1.00E-02	8.56E-06
TETRACHLOROETHENE	1.00E-03	4.89E-11	none	none	none		3.42E-09	1.00E-02	3.42E-07
* TOLUENE	3.78E-02	1.64E-09	NC	NC	NC		1.15E-07	2.00E-01	5.75E-07
CHEMICAL CLASS-SPECIFIC RISK =									
PCBs ^b									
AROCLOR 1260	2.10E-02	4.93E-13	7.70E+00	2.00E+00	9.86E-13	EPA	3.45E-11	2.00E-05	1.73E-06
CHEMICAL CLASS-SPECIFIC RISK =									
METALS ^e									
Chromium	2.31E+01	5.42E-10	NA	NA	NA		3.80E-08	1.50E+00	2.53E-08
Cobalt	2.38E+01	5.59E-10	NA	NA	NA		3.91E-08	6.00E-02	6.52E-07
Molybdenum	1.16E+00	2.72E-11	none	none	none		1.91E-09	5.00E-03	3.81E-07
Nickel	2.76E+01	6.47E-10	NA	NA	NA		4.53E-08	2.00E-02	none
Vanadium	7.93E+01	1.86E-09	NA	NA	NA		1.30E-07	7.00E-03	1.86E-05

Tbl. 6-6
 Future Construction Worker Scenario
 Cancer Risks and Toxicity Hazard from Subsurface Soil Exposure
 NMCRC-LA

CHEMICAL	Exposure Point Concentration (mg/kg)	CDI (cancer) (mg/kg-day)	California CSF (Chronic) (mg/kg-day)-1	EPA - CSF (Chronic) (mg/kg-day)-1	Cancer Risk based on EPA & CA CSF	CSF Used	CDI (noncancer) (mg/kg-day)	EPA - RfD (mg/kg-day)	Hazard based on EPA RfD
CHEMICAL CLASS-SPECIFIC RISK =									
PATHWAY-SPECIFIC RISK =					0.00E+00				
PATHWAY-SPECIFIC RISK (Petroleum) =					1.19E-10				
PATHWAY-SPECIFIC RISK (CERCLA-only) =					7.41E-11				
					4.47E-11				
DERMAL ROUTE									
SVOCs									
* BENZ(A)ANTHRACENE	1.40E-01	9.40E-11	9.00E-01	7.30E-01	6.86E-11	EPA	6.58E-09	2.00E-02	a 3.29E-07
* Benzo(a)pyrene	1.80E-01	1.21E-10	9.00E+00	7.30E+00	1.09E-09	CA	8.46E-09	2.00E-02	a 4.23E-07
* BENZO(B)FLUORANTHENE	2.90E-01	1.95E-10	9.00E-01	7.30E-01	1.42E-10	EPA	1.36E-08	2.00E-02	a 6.82E-07
* BENZO(G,H,I)PERYLENE	8.20E-02	5.51E-11	NC	NC	NC		3.86E-09	2.00E-02	a 1.93E-07
* CHRYSENE	2.20E-01	1.48E-10	9.00E-02	7.30E-03	1.33E-11	CA	1.03E-08	2.00E-02	a 5.17E-07
* FLUORANTHENE	2.95E-01	1.98E-10	NC	NC	NC		1.39E-08	2.00E-02	a 6.94E-07
* INDENO(1,2,3-CD)PYRENE	8.20E-02	5.51E-11	9.00E-01	7.30E-01	4.02E-11	EPA	3.86E-09	2.00E-02	a 1.93E-07
* 2-METHYLNAPHTHALENE	4.01E-01	2.70E-10	none	none	none		1.89E-08	2.00E-02	a 9.44E-07
* NAPHTHALENE	5.02E-01	3.37E-10	NC	NC	NC		2.36E-08	2.00E-02	a 1.18E-06
* PHENANTHRENE	2.00E-01	1.34E-10	NC	NC	NC		9.40E-09	2.00E-02	a 4.70E-07
* PYRENE	3.70E-01	2.49E-10	NC	NC	NC		1.74E-08	3.00E-02	5.80E-07
CHEMICAL CLASS-SPECIFIC RISK =					1.35E-09				
VOCs									
* 1,2,4-TRIMETHYLBENZENE	8.02E+00	4.14E-09	none	none	none		2.90E-07	1.00E-02	a 2.90E-05
1,2-DICHLOROETHANE	6.12E-03	3.16E-12	7.00E-02	9.10E-02	2.88E-13	EPA	2.21E-10	3.00E-02	b 7.38E-09
* 1,3,5-TRIMETHYLBENZENE	9.30E-01	4.81E-10	none	none	none		3.36E-08	1.00E-02	a 3.36E-06
2-BUTANONE (MEK)	7.87E-02	4.07E-11	NC	NC	NC		2.85E-09	6.00E-01	4.74E-09
ACETONE	1.13E-01	5.86E-11	NC	NC	NC		4.10E-09	1.00E-01	4.10E-08
* BENZENE	1.10E-02	5.67E-12	1.00E-02	1.50E-02	8.50E-14	EPA	3.97E-10	3.00E-03	b 1.32E-07
Carbon disulfide	7.43E-03	3.84E-12	none	none	none		2.69E-10	1.00E-01	2.69E-09
* ETHYLBENZENE	4.27E-01	2.20E-10	NC	NC	NC		1.54E-08	1.00E-01	1.54E-07
* ISOPROPYLBENZENE	6.28E-02	3.24E-11	none	none	none		2.27E-09	1.00E-02	a 2.27E-07
* M/P-XYLENE	7.74E-01	4.00E-10	NC	NC	NC		2.80E-08	2.00E+00	1.40E-08
METHYLENE CHLORIDE	2.80E-02	1.44E-11	3.50E-03	7.50E-03	1.08E-13	EPA	1.01E-09	6.00E-02	1.69E-08
* NAPHTHALENE	3.45E-01	1.78E-10	NC	NC	NC		1.25E-08	2.00E-02	6.24E-07
* N-BUTYLBENZENE	3.11E-03	1.61E-12	none	none	none		1.13E-10	1.00E-02	a 1.13E-08
* N-PROPYLBENZENE	7.56E-03	3.91E-12	none	none	none		2.74E-10	1.00E-02	a 2.74E-08
* O-XYLENE	1.39E-01	7.16E-11	NC	NC	NC		5.01E-09	2.00E+00	2.50E-09
* P-ISOPROPYLTOLUENE	3.91E-02	2.02E-11	none	none	none		1.41E-09	2.00E-01	a 7.06E-09
* SEC-BUTYLBENZENE	3.04E-02	1.57E-11	none	none	none		1.10E-09	1.00E-02	a 1.10E-07
* TERT-BUTYLBENZENE	6.30E-03	3.26E-12	none	none	none		2.28E-10	1.00E-02	a 2.28E-08
TETRACHLOROETHENE	1.00E-03	5.17E-13	none	none	none		3.62E-11	1.00E-02	3.62E-09
* TOLUENE	3.78E-02	1.95E-11	NC	NC	NC		1.37E-09	2.00E-01	6.83E-09
CHEMICAL CLASS-SPECIFIC RISK =					4.81E-13				
PCBs									
AROCLOR 1260	2.10E-02	1.52E-11	7.70E+00	2.00E+00	3.04E-11	EPA	1.06E-09	2.00E-05	5.32E-05
CHEMICAL CLASS-SPECIFIC RISK =					3.04E-11				
METALS									
Chromium	2.31E+01	1.19E-09	NA	NA	NA		8.36E-08	1.50E+00	b,e 5.57E-08
Cobalt	2.38E+01	1.23E-09	NA	NA	NA		8.61E-08	6.00E-02	c 1.43E-06
Molybdenum	1.16E+00	5.99E-11	none	none	none		4.20E-09	5.00E-03	8.39E-07

TABLE L-6
Future Construction Worker Scenario
Cancer Risks and Toxicity Hazard from Subsurface Soil Exposure
NMCRC-LA

CHEMICAL	Exposure Point Concentration (mg/kg)	CDI (cancer) (mg/kg-day)	California CSF (Chronic) (mg/kg-day) ⁻¹	EPA - CSF (Chronic) (mg/kg-day) ⁻¹	Cancer Risk based on EPA & CA CSF	CSF Used	CDI (noncancer) (mg/kg-day)	EPA - RfD (mg/kg-day)	Hazard based on EPA RfD
Nickel	2.70E+01	1.42E-09	NA	NA	NA		9.96E-08	2.00E-02	none
Vanadium	7.93E+01	4.10E-09	NA	NA	NA		2.87E-07	7.00E-03	4.10E-05
CHEMICAL CLASS-SPECIFIC RISK =					0.00E+00				4.33E-05
PATHWAY-SPECIFIC RISK =					1.38E-09				1.36E-04
PATHWAY-SPECIFIC RISK (Petroleum) =					1.35E-09				3.99E-05
PATHWAY-SPECIFIC RISK (CERCLA-only) =					3.08E-11				9.65E-05
TOTAL:					CUMULATIVE CANCER RISK =	CUMULATIVE TOXICITY HAZARD =			
Petroleum-related:					2.31E-09	9.16E-03			
CERCLA-only:					2.21E-09	9.03E-03			
					9.23E-11	1.30E-04			

* = Petroleum-related chemical
CPF = Cancer Potency Factor
CDI = chronic daily intake
mg/kg-day = milligrams per kilogram per day
EPC = Exposure Point Concentration
NA = Not Available
NC = Not a known carcinogen
NMCRC-LA= Naval and Marine Corps Reserve Center- Los Angeles
RfD = Reference Dose
a = No RfD located. Surrogate toxicity value used based on structure relationship
b= Surrogate toxicity value used based on EPA Region IX PRG Table, October 1999.
c = Chemicals having a Henry's Law Constant below 10⁻⁵ and a molecular weight greater than 200 g/mol.
d = Chemicals having a Henry's Law Constant greater than 10⁻⁵ and a molecular weight less than 200 g/mol.
e = Toxicity criteria from EPA Region IX Preliminary Remediation Goals 1999
f = If a CPF was available from the U.S. EPA but not from the California EPA, the EPA CPF was used in California EPA calculations.

Table L-7
Future Industrial Risk Scenario
Cancer Risks and Toxicity Hazard from Subsurface Soil Exposure
NMCRC-LA

CHEMICAL	Exposure Point Concentration (mg/kg)	CDI (cancer) (mg/kg-day)	California CSF (Chronic) (mg/kg-day)-1	EPA - CSF (Chronic) (mg/kg-day)-1	Cancer Risk based on EPA & CA CSF	CSF Used	CDI (noncancer) (mg/kg-day)	EPA - RfD (mg/kg-day)	Hazard based on EPA RfD
SOIL INGESTION ROUTE									
SVOCs									
* BENZ(A)ANTHRACENE	1.40E-01	2.45E-08	9.00E-01	7.30E-01	1.79E-08	EPA	6.85E-08	2.00E-02	3.42E-06
* Benzo(a)pyrene	1.80E-01	3.15E-08	9.00E+00	7.30E+00	2.83E-07	CA	8.81E-08	2.00E-02	4.40E-06
* BENZO(B)FLUORANTHENE	2.90E-01	5.07E-08	9.00E-01	7.30E-01	3.70E-08	EPA	1.42E-07	2.00E-02	7.09E-06
* BENZO(G,H,I)PERYLENE	8.20E-02	1.43E-08	NC	NC	NC		4.01E-08	2.00E-02	2.01E-06
* CHRYSENE	2.20E-01	3.84E-08	9.00E-02	7.30E-03	3.46E-09	CA	1.08E-07	2.00E-02	5.38E-06
* FLUORANTHENE	2.95E-01	5.16E-08	NC	NC	NC		1.44E-07	2.00E-02	7.22E-06
* INDENOX(1,2,3-CD)PYRENE	8.20E-02	1.43E-08	9.00E-01	7.30E-01	1.05E-08	EPA	4.01E-08	2.00E-02	2.01E-06
* 2-METHYLNAPHTHALENE	4.01E-01	7.01E-08	NC	NC	NC		1.96E-07	2.00E-02	9.82E-06
* NAPHTHALENE	5.02E-01	8.78E-08	NC	NC	NC		2.46E-07	2.00E-02	1.23E-05
* PHENANTHRENE	2.00E-01	3.49E-08	NC	NC	NC		9.78E-08	2.00E-02	4.89E-06
* PYRENE	3.70E-01	6.46E-08	NC	NC	NC		1.81E-07	3.00E-02	6.03E-06
CHEMICAL CLASS-SPECIFIC RISK =									
VOCs									
* 1,2,4-TRIMETHYLBENZENE	8.02E+00	1.40E-06	none	none	none		3.92E-06	1.00E-02	1.40E-04
1,2-DICHLOROETHANE	6.12E-03	1.07E-09	7.00E-02	9.10E-02	9.73E-11	EPA	2.99E-09	3.00E-02	3.56E-08
* 1,3,5-TRIMETHYLBENZENE	9.30E-01	1.63E-07	none	none	none		4.53E-07	1.00E-02	1.63E-05
2-BUTANONE (MEK)	7.87E-02	1.38E-08	NC	NC	NC		3.85E-08	6.00E-01	2.29E-08
ACETONE	1.13E-01	1.98E-08	NC	NC	NC		5.55E-08	1.00E-01	1.98E-07
* BENZENE	1.10E-02	1.92E-09	1.00E-02	1.50E-02	2.88E-11	EPA	5.37E-09	3.00E-03	6.39E-07
Carbon disulfide	7.43E-03	1.30E-09	none	none	none		3.64E-09	1.00E-01	1.30E-08
* ETHYLBENZENE	4.27E-01	7.46E-08	NC	NC	NC		2.09E-07	1.00E-01	7.46E-07
* ISOPROPYLBENZENE	6.28E-02	1.10E-08	none	none	none		3.07E-08	1.00E-02	1.10E-06
* M/P-XYLENE	7.74E-01	1.35E-07	NC	NC	NC		3.79E-07	2.00E+00	6.76E-08
METHYLENE CHLORIDE	2.80E-02	4.89E-09	3.50E-03	7.50E-03	3.66E-11	EPA	1.37E-08	6.00E-02	8.14E-08
* NAPHTHALENE	3.45E-01	6.03E-08	NC	NC	NC		1.69E-07	2.00E-02	3.02E-06
* N-BUTYLBENZENE	3.11E-03	5.44E-10	none	none	none		1.52E-09	1.00E-02	5.44E-08
* N-PROPYLBENZENE	7.56E-03	1.32E-09	none	none	none		3.70E-09	1.00E-02	1.32E-07
* O-XYLENE	1.39E-01	2.42E-08	NC	NC	NC		6.78E-08	2.00E+00	1.21E-08
* P-ISOPROPYLTOLUENE	3.91E-02	6.82E-09	none	none	none		1.91E-08	2.00E-01	3.41E-08
* SEC-BUTYLBENZENE	3.04E-02	5.31E-09	none	none	none		1.49E-08	1.00E-02	5.31E-07
* TERT-BUTYLBENZENE	6.30E-03	1.10E-09	none	none	none		3.08E-09	1.00E-02	1.10E-07
TETRACHLOROETHENE	1.60E-03	1.75E-10	none	none	none		4.89E-10	1.00E-02	1.75E-08
* TOLUENE	3.78E-02	6.60E-09	NC	NC	NC		1.85E-08	2.00E-01	3.30E-08
CHEMICAL CLASS-SPECIFIC RISK =									
PCBs					1.63E-10		5.41E-06		1.63E-04
AROCFLOR 1260	2.10E-02	3.67E-09	7.70E+00	2.00E+00	7.34E-09	EPA	3.67E-09	2.00E-05	1.83E-04
CHEMICAL CLASS-SPECIFIC RISK =									
METALS									
Chromium	2.31E+01	4.04E-06	NA	NA	NA		1.13E-05	1.50E+00	2.69E-06
Cobalt	2.38E+01	4.16E-06	NA	NA	NA		1.16E-05	6.00E-02	6.93E-05
Molybdenum	1.16E+00	2.03E-07	none	none	none		5.68E-07	5.00E-03	4.05E-05
Nickel	2.76E+01	4.81E-06	NA	NA	NA		1.35E-05	2.00E-02	none
Vanadium	7.93E+01	1.39E-05	NA	NA	NA		3.88E-05	7.00E-03	1.98E-03
CHEMICAL CLASS-SPECIFIC RISK =									
PATHWAY-SPECIFIC RISK =									
PATHWAY-SPECIFIC RISK (Petroleum) =									
PATHWAY-SPECIFIC RISK (CERCLA-only) =									

TABLE L-7
Future Industrial Worker Scenario
Cancer Risks and Toxicity Hazard from Subsurface Soil Exposure
NMCRC-LA

CHEMICAL	Exposure Point Concentration (mg/kg)	CDI (cancer) (mg/kg-day)	California CSF (Chronic) (mg/kg-day)-1	EPA - CSF (Chronic) (mg/kg-day)-1	Cancer Risk based on EPA & CA CSF	CSF Used	CDI (noncancer) (mg/kg-day)	EPA - RfD (mg/kg-day)	Hazard based on EPA RfD
INHALATION ROUTE - Particulates/ Vapors ^d									
SVOCs ^e									
* BENZ(A)ANTHRACENE	1.40E-01	7.44E-12	9.00E-01	7.30E-01	5.43E-12	EPA	2.08E-11	2.00E-02	1.04E-09
* Benzo(a)pyrene	1.80E-01	9.50E-12	9.00E+00	7.30E+00	8.60E-11	CA	2.68E-11	2.00E-02	1.34E-09
* BENZO(B)FLUORANTHENE	2.90E-01	1.54E-11	9.00E-01	7.30E-01	1.12E-11	EPA	4.31E-11	2.00E-02	2.16E-09
* BENZO(G,H,I)PERYLENE	8.20E-02	1.22E-11	NC	NC	NC		1.22E-11	2.00E-02	6.10E-10
* CHRYSENE	2.20E-01	3.27E-11	0.09	7.30E-03	2.94E-12	CA	3.27E-11	2.00E-02	1.64E-09
* FLUORANTHENE	2.95E-01	4.39E-11	NC	NC	NC		4.39E-11	2.00E-02	2.19E-09
* INDENO(1,2,3-CD)PYRENE	8.20E-02	4.35E-12	0.9	7.30E-01	3.18E-12	EPA	1.22E-11	2.00E-02	6.10E-10
* 2-METHYLNAPHTHALENE	4.01E-01	5.97E-11	NC	NC	NC		5.97E-11	2.00E-02	2.99E-09
* NAPHTHALENE	5.02E-01	7.47E-11	NC	NC	NC		7.47E-11	2.00E-02	3.73E-09
* PHENANTHRENE	2.00E-01	2.97E-11	NC	NC	NC		2.97E-11	2.00E-02	1.49E-09
* PYRENE	3.70E-01	5.50E-11	NC	NC	NC		5.50E-11	3.00E-02	1.83E-09
CHEMICAL CLASS-SPECIFIC RISK =					1.09E-10		4.11E-10		1.96E-08
VOCs ^d									
* 1,2,4-TRIMETHYLBENZENE	8.02E+00	4.94E-04	none	none	none		1.38E-03	1.00E-02	1.38E-01
1,2-DICHLOROETHANE	6.12E-03	1.14E-07	7.00E-02	9.10E-02	1.03E-08	EPA	3.18E-07	3.00E-02	1.06E-05
* 1,3,5-TRIMETHYLBENZENE	9.30E-01	6.95E-05	none	none	none		1.95E-04	1.00E-02	1.95E-02
2-BUTANONE (MEK)	7.87E-02	2.90E-07	NC	NC	NC		8.11E-07	6.00E-01	1.35E-06
ACETONE	1.13E-01	1.02E-06	NC	NC	NC		2.86E-06	1.00E-01	2.86E-05
* BENZENE	1.10E-02	8.00E-07	1.00E-02	1.50E-02	1.20E-08	EPA	2.24E-06	3.00E-03	7.46E-04
Carbon disulfide	7.43E-03	5.60E-07	none	none	none		1.57E-06	1.00E-01	1.57E-05
* ETHYLBENZENE	4.27E-01	3.22E-05	NC	NC	NC		9.00E-05	1.00E-01	9.00E-04
* ISOPROPYLBENZENE	6.28E-02	2.50E-07	none	none	none		6.99E-07	1.00E-02	6.99E-05
* M/P-XYLENE	7.74E-01	6.00E-06	NC	NC	NC		1.70E-05	2.00E+00	8.49E-06
METHYLENE CHLORIDE	2.80E-02	1.23E-06	3.50E-03	7.50E-03	9.20E-09	EPA	3.43E-06	6.00E-02	5.72E-05
* NAPHTHALENE	3.45E-01	8.57E-07	NC	NC	NC		2.40E-06	2.00E-02	1.20E-04
* N-BUTYLBENZENE	3.11E-03	1.45E-09	none	none	none		4.06E-09	1.00E-02	4.06E-07
* N-PROPYLBENZENE	7.56E-03	3.52E-09	none	none	none		9.85E-09	1.00E-02	9.85E-07
* O-XYLENE	1.39E-01	1.08E-06	NC	NC	NC		3.04E-06	2.00E+00	1.52E-06
* P-ISOPROPYLTOLUENE	3.91E-02	4.30E-08	none	none	none		1.21E-07	2.00E-01	6.03E-07
* SEC-BUTYLBENZENE	3.04E-02	2.87E-06	none	none	none		8.04E-06	1.00E-02	8.04E-04
* TERT-BUTYLBENZENE	6.30E-03	5.46E-07	none	none	none		1.53E-06	1.00E-02	1.53E-04
TETRACHLOROETHENE	1.00E-03	2.18E-08	none	none	none		6.12E-08	1.00E-02	6.12E-06
* TOLUENE	3.78E-02	7.34E-07	NC	NC	NC		2.05E-06	2.00E-01	1.03E-05
CHEMICAL CLASS-SPECIFIC RISK =					3.15E-08		1.71E-03		1.61E-01
PCBs ^e									
AROCLOR 1260	2.10E-02	3.12E-12	7.70E+00	2.00E+00	6.25E-12	EPA	3.12E-12	2.00E-05	1.56E-07
CHEMICAL CLASS-SPECIFIC RISK =					6.25E-12		3.12E-12		1.56E-07
METALS ^e									
Chromium	2.31E+01	3.44E-09	NA	NA	NA		3.44E-09	1.50E+00	2.29E-09
Cobalt	2.38E+01	3.54E-09	NA	NA	NA		3.54E-09	6.00E-02	5.90E-08
Molybdenum	1.16E+00	1.72E-10	none	none	none		1.72E-10	5.00E-03	3.45E-08
Nickel	2.76E+01	4.10E-09	NA	NA	NA		4.10E-09	2.00E-02	none
Vanadium	7.93E+01	1.18E-08	NA	NA	NA		1.18E-08	7.00E-03	1.68E-06
CHEMICAL CLASS-SPECIFIC RISK =					0.00E+00		2.30E-08		1.78E-06
PATHWAY-SPECIFIC RISK =									
PATHWAY-SPECIFIC RISK (Petroleum) =					3.16E-08		1.71E-03		1.61E-01
PATHWAY-SPECIFIC RISK (CERCLA-only) =					1.21E-08		1.60E-01		1.60E-01
					1.95E-08		-1.59E-01		1.22E-04

TA - L-7
 Future Industrial Worker Scenario
 Cancer Risks and Toxicity Hazards from Subsurface Soil Exposure
 NM/CRC-LA

CHEMICAL	Exposure Point Concentration (mg/kg)	CDI (cancer) (mg/kg-day)	California CSF (Chronic) (mg/kg-day)-1	EPA - CSF (Chronic) (mg/kg-day)-1	Cancer Risk based on EPA & CA CSF	CSF Used	CDI (noncancer) (mg/kg-day)	EPA - RfD (mg/kg-day)	Hazard based on EPA RfD
DERMAL ROUTE									
SVOCs									
* BENZO(A)ANTHRACENE	1.40E-01	4.20E-08	9.00E-01	7.30E-01	3.06E-08	EPA	1.18E-07	2.00E-02	5.88E-06
* Benzo(a)pyrene	1.80E-01	5.40E-08	9.00E+00	7.30E+00	4.86E-07	CA	1.51E-07	2.00E-02	7.56E-06
* BENZO(B)FLUORANTHENE	2.90E-01	8.70E-08	9.00E-01	7.30E-01	6.35E-08	EPA	2.43E-07	2.00E-02	1.22E-05
* BENZO(G,H,I)PERYLENE	8.20E-02	2.46E-08	NC	NC	NC		6.88E-08	2.00E-02	3.44E-06
* CHRYSENE	2.20E-01	6.60E-08	9.00E-02	7.30E-03	5.94E-09	CA	1.85E-07	2.00E-02	9.23E-06
* FLUORANTHENE	2.95E-01	8.85E-08	NC	NC	NC		2.48E-07	2.00E-02	1.24E-05
* INDENO(1,2,3-CD)PYRENE	8.20E-02	2.46E-08	9.00E-01	7.30E-01	1.79E-08	EPA	6.88E-08	2.00E-02	3.44E-06
* 2-METHYLNAPHTHALENE	4.01E-01	1.20E-07	none	none	none		3.37E-07	2.00E-02	1.69E-05
* NAPHTHALENE	5.02E-01	1.51E-07	NC	NC	NC		4.22E-07	2.00E-02	2.11E-05
* PHENANTHRENE	2.90E-01	6.00E-08	NC	NC	NC		1.68E-07	2.00E-02	8.40E-06
* PYRENE	3.70E-01	1.11E-07	NC	NC	NC		3.11E-07	3.00E-02	1.04E-05
CHEMICAL CLASS-SPECIFIC RISK =									
VOCs									
* 1,2,4-TRIMETHYLBENZENE	8.02E+00	1.85E-06	none	none	none		5.18E-06	1.00E-02	5.18E-04
1,2-DICHLOROETHANE	6.12E-03	1.41E-09	7.00E-02	9.10E-02	1.28E-10	EPA	3.95E-09	3.00E-02	1.32E-07
* 1,3,5-TRIMETHYLBENZENE	9.30E-01	2.15E-07	none	none	none		6.01E-07	1.00E-02	6.01E-05
* 2-BUTANONE (MEK)	7.87E-02	1.82E-08	NC	NC	NC		5.08E-08	6.00E-01	8.47E-08
ACETONE	1.13E-01	2.62E-08	NC	NC	NC		7.32E-08	1.00E-01	7.32E-07
* BENZENE	1.10E-02	2.53E-09	1.00E-02	1.50E-02	3.80E-11	EPA	7.09E-09	3.00E-03	2.36E-06
Carbon disulfide	7.43E-03	1.71E-09	none	none	none		4.80E-09	1.00E-01	4.80E-08
* ETHYLBENZENE	4.27E-01	9.84E-08	NC	NC	NC		2.76E-07	1.00E-01	2.76E-06
* ISOPROPYLBENZENE	6.28E-02	1.45E-08	none	none	none		4.03E-08	1.00E-02	4.05E-06
* M/P-XYLENE	7.74E-01	1.79E-07	NC	NC	NC		5.00E-07	2.00E+00	2.50E-07
* METHYLENE CHLORIDE	2.80E-02	6.45E-09	3.50E-03	7.50E-03	4.84E-11	EPA	1.81E-08	6.00E-02	3.01E-07
* NAPHTHALENE	3.45E-01	7.96E-08	NC	NC	NC		2.23E-07	2.00E-02	1.11E-05
* N-BUTYLBENZENE	3.11E-03	7.18E-10	none	none	none		2.01E-09	1.00E-02	2.01E-07
* N-PROPYLBENZENE	7.56E-03	1.74E-09	none	none	none		4.88E-09	1.00E-02	4.88E-07
* O-XYLENE	1.39E-01	3.19E-08	NC	NC	NC		8.94E-08	2.00E+00	4.47E-08
* P-ISOPROPYL-TOLUENE	3.91E-02	9.01E-09	none	none	none		2.52E-08	2.00E-01	1.26E-07
* SEC-BUTYLBENZENE	3.04E-02	7.01E-09	none	none	none		1.96E-08	1.00E-02	1.96E-06
* TERT-BUTYLBENZENE	6.30E-03	1.45E-09	none	none	none		4.07E-09	1.00E-02	4.07E-07
TETRACHLOROETHENE	1.00E-03	2.31E-10	none	none	none		6.46E-10	1.00E-02	6.46E-08
* TOLUENE	3.78E-02	8.72E-09	NC	NC	NC		2.44E-08	2.00E-01	1.22E-07
CHEMICAL CLASS-SPECIFIC RISK =									
PCBs									
AROCLOR 1260	2.10E-02	6.78E-09	7.70E+00	2.00E+00	1.36E-08	EPA	6.78E-09	2.00E-05	3.39E-04
CHEMICAL CLASS-SPECIFIC RISK =									
METALS									
Chromium	2.31E+01	5.33E-07	NA	NA	NA		5.33E-07	1.50E+00	3.55E-07
Cobalt	2.38E+01	5.49E-07	NA	NA	NA		5.49E-07	6.00E-02	9.15E-06
Molybdenum	1.16E+00	2.68E-08	none	none	none		2.68E-08	5.00E-03	5.35E-06
Nickel	2.76E+01	6.35E-07	NA	NA	NA		6.35E-07	2.00E-02	none
Vanadium	7.93E+01	1.83E-06	NA	NA	NA		1.83E-06	7.00E-03	2.61E-04
CHEMICAL CLASS-SPECIFIC RISK =									
PATHWAY-SPECIFIC RISK =									
PATHWAY-SPECIFIC RISK (Petroleum) =									
PATHWAY-SPECIFIC RISK (CERCLA-only) =									
					6.18E-07		1.30E-05		1.33E-03
					6.04E-07		7.13E-04		7.13E-04
					1.37E-08		-7.00E-04		6.17E-04

TABLE L-7
Future Industrial Worker Scenario
Cancer Risks and Toxicity Hazard from Subsurface Soil Exposure
NMCRC-LA

CHEMICAL	Exposure Point Concentration (mg/kg)	CDI (cancer) (mg/kg-day)	California CSF (Chronic) (mg/kg-day)-1	EPA - CSF (Chronic) (mg/kg-day)-1	Cancer Risk based on EPA & CA CSF	CSF Used	CDI (noncancer) (mg/kg-day)	EPA - RfD (mg/kg-day)	Hazard based on EPA RfD
TOTAL:									
Petroleum-related:									
CERCLA-only:									
				CANCER	1.01E-06		1.81E-03	##	1.64E-01
					9.68E-07		1.61E-01	##	1.61E-01
					4.07E-08		-1.60E-01	##	3.01E-03

* = Petroleum-related chemical
CPF = Cancer Potency Factor
CDI = chronic daily intake
mg/kg-day = milligrams per kilogram per day
EPC = Exposure Point Concentration
NA = Not Available
NC = Not a known carcinogen
NMCRC-LA= Naval and Marine Corps Reserve Center- Los Angeles
RfD = Reference Dose
a = No RfD located. Surrogate toxicity value used based on structure relationship
b= Surrogate toxicity value used based on EPA Region IX PRG Table, 1999
c = Chemicals having a Henry's Law Constant below 10⁻⁵ and a molecular weight greater than 200 g/mol.
d = Chemicals having a Henry's Law Constant greater than 10⁻⁵ and a molecular weight less than 200 g/mol.
e = Toxicity criteria from EPA Region 9 Preliminary Remediation Goals 1999
f = If a CPF was available from the U.S. EPA but not from the California EPA, the EPA CPF was used in California EPA calculations.

TABLE L-8
FUTURE RESIDENTIAL SCENARIO FOR ADULT AND CHILD
CANCER RISKS AND TOXICITY HAZARD FROM SUBSURFACE SOIL EXPOSURE
NMCRC-LA

CHEMICAL	EPC (mg/kg)	CDI (cancer) (mg/kg-day)	California CSF (Chronic) (mg/kg-day) ⁻¹	EPA - CSF (Chronic) (mg/kg-day) ⁻¹	Cancer Risk based on EPA & CA CSF	CSF Used	Adult CDI (nontancer) (mg/kg-day)	Child CDI (nontancer)	EPA - RfD (mg/kg-day)	Adult Hazard based on EPA RfD	Child Hazard based on EPA RfD
SOIL INGESTION ROUTE											
SVOCs											
* BENZ(A)ANTHRACENE	1.40E-01	2.19E-07	9.00E-01	7.30E-01	1.60E-07	EPA	1.92E-07	1.79E-06	2.00E-02	9.59E-06	8.95E-05
* Benzo(a)Pyrene	1.80E-01	2.81E-07	9.00E+00	7.30E+00	2.53E-06	CA	2.47E-07	2.30E-06	2.00E-02	1.23E-05	1.15E-04
* BENZO(B)FLUORANTHENE	2.90E-01	4.53E-07	9.00E-01	7.30E-01	3.31E-07	EPA	3.97E-07	3.71E-06	2.00E-02	1.99E-05	1.85E-04
* BENZO(G,H,I)PERYLENE	8.20E-02	1.28E-07	NC	NC	NC	NC	1.12E-07	1.03E-06	2.00E-02	5.62E-06	5.24E-05
* CHRYSENE	2.20E-01	3.44E-07	9.00E-02	7.30E-03	3.09E-08	CA	3.01E-07	2.81E-06	2.00E-02	1.51E-05	1.41E-04
* FLUORANTHENE	2.95E-01	4.61E-07	NC	NC	NC	NC	4.04E-07	3.77E-06	2.00E-02	2.02E-05	1.89E-04
* INDENO(1,2,3-CD)PYRENE	8.20E-02	1.28E-07	9.00E-01	7.30E-01	9.35E-08	EPA	1.12E-07	1.05E-06	2.00E-02	5.62E-06	5.24E-05
* 2-METHYLNAPHTHALENE	4.01E-01	6.27E-07	none	none	none	none	5.50E-07	5.13E-06	2.00E-02	2.75E-05	2.57E-04
* NAPHTHALENE	5.02E-01	7.84E-07	NC	NC	NC	NC	6.88E-07	6.42E-06	2.00E-02	3.44E-05	3.21E-04
* PHENANTHRENE	2.00E-01	3.12E-07	NC	NC	NC	NC	2.74E-07	2.56E-06	2.00E-02	1.37E-05	1.28E-04
* PYRENE	3.70E-01	5.78E-07	NC	NC	NC	NC	5.07E-07	4.73E-06	3.00E-02	1.69E-05	1.58E-04
CHEMICAL CLASS-SPECIFIC RISK =					3.14E-06					1.81E-04	1.69E-03
VOCs											
* 1,2,4-TRIMETHYLBENZENE	8.02E+00	1.25E-05	none	none	none	none	1.10E-05	1.03E-04	3.00E-02	3.66E-04	3.42E-03
1,2-DICHLOROETHANE	6.12E-03	9.55E-09	7.00E-02	9.10E-02	8.69E-10	EPA	8.38E-09	7.82E-08	3.00E-02	2.79E-07	2.61E-06
* 1,3,5-TRIMETHYLBENZENE	9.30E-01	1.45E-06	none	none	none	none	1.27E-06	1.19E-05	3.00E-02	4.25E-05	3.96E-04
2-BUTANONE (MEK)	7.87E-02	1.23E-07	NC	NC	NC	NC	1.08E-07	1.01E-06	3.00E-02	3.59E-06	3.35E-05
ACETONE	1.13E-01	1.77E-07	NC	NC	NC	NC	1.55E-07	1.45E-06	3.00E-02	5.18E-06	4.83E-05
* BENZENE	1.10E-02	1.71E-08	1.00E-02	1.50E-02	2.57E-10	EPA	1.50E-08	1.40E-07	3.00E-02	5.01E-07	4.68E-06
Carbon Disulfide	7.43E-03	1.16E-08	none	none	none	none	1.02E-08	9.50E-08	1.00E-01	1.02E-07	9.50E-07
* ETHYLBENZENE	4.27E-01	6.66E-07	NC	NC	NC	NC	5.85E-07	5.46E-06	3.00E-02	1.95E-05	1.82E-04
* ISOPROPYLBENZENE	6.28E-02	9.80E-08	none	none	none	none	8.60E-08	8.03E-07	3.00E-02	2.87E-06	2.68E-05
* M/P-XYLENE	7.74E-01	1.21E-06	NC	NC	NC	NC	1.06E-06	9.90E-06	3.00E-02	3.54E-05	3.30E-04
METHYLENE CHLORIDE	2.80E-02	4.37E-08	3.50E-03	7.50E-03	3.28E-10	EPA	3.83E-08	3.58E-07	3.00E-02	1.28E-06	1.19E-05
* NAPHTHALENE	3.45E-01	5.39E-07	NC	NC	NC	NC	4.73E-07	4.41E-06	3.00E-02	1.58E-05	1.47E-04
* N-BUTYLBENZENE	3.11E-03	4.86E-09	none	none	none	none	4.27E-09	3.98E-08	3.00E-02	1.42E-07	1.33E-06
* N-PROPYLBENZENE	7.56E-03	1.18E-08	none	none	none	none	1.04E-08	9.67E-08	3.00E-02	3.45E-07	3.22E-06
* O-XYLENE	1.39E-01	2.16E-07	NC	NC	NC	NC	1.90E-07	1.77E-06	3.00E-02	6.32E-06	5.90E-05
* P-ISOPROPYLTOLUENE	3.91E-02	6.10E-08	none	none	none	none	5.55E-08	4.99E-07	3.00E-02	1.78E-06	1.66E-05
* SEC-BUTYLBENZENE	3.04E-02	4.75E-08	none	none	none	none	4.16E-08	3.89E-07	3.00E-02	1.39E-06	1.30E-05
* TERT-BUTYLBENZENE	6.30E-03	9.84E-09	none	none	none	none	8.63E-09	8.06E-08	3.00E-02	2.88E-07	2.69E-06
TETRACHLOROETHENE	1.00E-03	1.56E-09	none	none	none	none	1.37E-09	1.28E-08	3.00E-02	4.57E-08	4.26E-07
* TOLUENE	3.78E-02	5.90E-08	NC	NC	NC	NC	5.18E-08	4.83E-07	3.00E-02	1.73E-06	1.61E-05
CHEMICAL CLASS-SPECIFIC RISK =					1.45E-09					5.05E-04	4.71E-03
PCBs											
AROCLOR 1260	2.10E-02	3.28E-08	7.70E+00	2.00E+00	6.56E-08	EPA	2.88E-08	2.68E-07	3.00E-02	9.59E-07	8.95E-06
CHEMICAL CLASS-SPECIFIC RISK =					6.56E-08					9.59E-07	

TABLE L-8
FUTURE RESIDENTIAL SCENARIO FOR ADULT AND CHILD
CANCER RISKS AND TOXICITY HAZARD FROM SUBSURFACE SOIL EXPOSURE
NMCRC-LA

CHEMICAL	EPC (mg/kg)	CDI (cancer) (mg/kg-day)	California CSF (Chronic) (mg/kg-day) ⁻¹	EPA - CSF (Chronic) (mg/kg-day) ⁻¹	Cancer Risk based on EPA & CA CSF	CSF Used	Adult CDI (noncancer) (mg/kg-day)	Child CDI (noncancer)	EPA - RfD (mg/kg-day)	Adult Hazard based on EPA RfD	Child Hazard based on EPA RfD
METALS											
Chromium	2.31E+01	3.61E-05	NA	NA	NA		3.17E-05	2.95E-04	1.50E+00	2.11E-05	1.97E-04
Cobalt	2.38E+01	3.72E-05	NA	NA	NA		3.26E-05	3.04E-04	6.00E-02	5.43E-04	5.07E-03
Molybdenum	1.16E+00	1.81E-06	none	none	none		1.59E-06	1.48E-05	5.00E-03	3.18E-04	2.97E-03
Nickel	2.76E+01	4.30E-05	NA	NA	NA		3.77E-05	3.52E-04	2.00E-02	1.89E-03	1.76E-02
Vanadium	7.93E+01	1.24E-04	NA	NA	NA		1.09E-04	1.01E-03	7.00E-03	1.55E-02	1.45E-01
CHEMICAL CLASS-SPECIFIC RISK =											
0.00E+00											
1.83E-02											
1.71E-01											
PATHWAY-SPECIFIC RISK =											
3.21E-06											
PATHWAY-SPECIFIC RISK (Petroleum) =											
3.14E-06											
PATHWAY-SPECIFIC RISK (CERCLA-only) =											
6.68E-08											
1.83E-02											
1.71E-01											
1.90E-02											
6.30E-03											
1.71E-01											
INHALATION ROUTE - Particulates ^c /Vapors ^d											
SVOCs ^c											
* BENZ(A)ANTHRACENE	1.40E-01	1.60E-11	9.00E-01	7.30E-01	1.17E-11	EPA	2.91E-11	6.80E-11	2.00E-02	1.46E-09	3.40E-09
* Benzo(a)pyrene	1.80E-01	2.06E-11	9.00E+00	7.30E+00	1.85E-10	CA	3.75E-11	8.74E-11	2.00E-02	1.87E-09	4.37E-09
* BENZO(B)FLUORANTHENE	2.90E-01	3.32E-11	9.00E-01	7.30E-01	2.42E-11	EPA	6.04E-11	1.41E-10	2.00E-02	3.02E-09	7.04E-09
* BENZO(G,H,I)PERYLENE	8.20E-02	9.39E-12	NC	NC	NC		1.71E-11	3.98E-11	2.00E-02	8.54E-10	1.99E-09
* CHRYSENE	2.20E-01	2.52E-11	9.00E-02	7.30E-03	2.27E-12	CA	4.58E-11	1.07E-10	2.00E-02	2.29E-09	5.34E-09
* FLUORANTHENE	2.95E-01	3.38E-11	NC	NC	NC		6.14E-11	1.43E-10	2.00E-02	3.07E-09	7.17E-09
* INDENO(1,2,3-CD)PYRENE	8.20E-02	9.39E-12	9.00E-01	7.30E-01	6.85E-12	EPA	1.71E-11	3.98E-11	2.00E-02	8.54E-10	1.99E-09
* 2-METHYLNAPHTHALENE	4.01E-01	4.60E-11	none	none	NC		8.36E-11	1.95E-10	2.00E-02	4.18E-09	9.75E-09
* NAPHTHALENE	5.02E-01	5.75E-11	NC	NC	NC		1.05E-10	2.44E-10	2.00E-02	5.23E-09	1.22E-08
* PHENANTHRENE	2.00E-01	2.29E-11	NC	NC	NC		4.16E-11	9.72E-11	2.00E-02	2.08E-09	4.86E-09
* PYRENE	3.70E-01	4.24E-11	NC	NC	NC		7.70E-11	1.80E-10	3.00E-02	2.57E-09	5.99E-09
CHEMICAL CLASS-SPECIFIC RISK =											
2.31E-10											
VOCs ^d											
* 1,2,4-TRIMETHYLBENZENE	8.02E+00	1.06E-03	none	none	none		1.93E-09	4.51E-09	1.00E-02	1.93E-07	4.51E-07
1,2-DICHLOROETHANE	6.12E-03	2.45E-07	7.00E-02	9.10E-02	1.71E-08	EPA	4.45E-13	1.04E-12	3.00E-02	1.48E-11	3.46E-11
* 1,3,5-TRIMETHYLBENZENE	9.30E-01	1.50E-04	none	none	none		2.73E-10	6.36E-10	1.00E-02	2.73E-08	6.36E-08
2-BUTANONE (MEK)	7.87E-02	6.24E-07	NC	NC	NC		1.14E-12	2.65E-12	6.00E-01	1.89E-12	4.41E-12
ACETONE	1.13E-01	2.21E-06	NC	NC	NC		4.01E-12	9.36E-12	1.00E-01	4.01E-11	9.36E-11
* BENZENE	1.10E-02	1.72E-06	1.00E-02	1.50E-02	2.59E-08	EPA	3.13E-12	7.31E-12	3.00E-03	1.04E-09	2.44E-09
Carbon disulfide	7.43E-03	1.21E-06	none	none	none		2.20E-12	5.12E-12	1.00E-01	2.20E-11	5.12E-11
* ETHYLBENZENE	4.27E-01	6.93E-05	NC	NC	NC		1.26E-10	2.94E-10	1.00E-01	1.26E-09	2.94E-09
* ISOPROPYLBENZENE	6.28E-02	5.38E-07	none	none	none		9.78E-13	2.28E-12	1.00E-02	9.78E-11	2.28E-10
* M/P-XYLENE	7.74E-01	1.31E-05	NC	NC	NC		2.38E-11	5.54E-11	2.00E+00	1.19E-11	2.77E-11
METHYLENE CHLORIDE	2.80E-02	2.64E-06	3.50E-03	7.50E-03	1.98E-08	EPA	4.81E-12	1.12E-11	6.00E-02	8.01E-11	1.87E-10
* NAPHTHALENE	3.45E-01	1.85E-06	NC	NC	NC		3.36E-12	7.84E-12	2.00E-02	1.68E-10	3.92E-10
* N-BUTYLBENZENE	3.11E-03	3.12E-09	none	none	none		5.68E-15	1.33E-14	1.00E-02	5.68E-13	1.33E-12

TABLE L-8
FUTURE RESIDENTIAL SCENARIO FOR ADULT AND CHILD
CANCER RISKS AND TOXICITY HAZARD FROM SUBSURFACE SOIL EXPOSURE
NMCRC-LA

CHEMICAL	EPC (mg/kg)	CDI (cancer) (mg/kg-day)	California CSF (Chronic) (mg/kg-day)-1	EPA - CSF (Chronic) (mg/kg-day)-1	Cancer Risk based on EPA & CA CSF	CSF Used	Adult CDI (noncancer) (mg/kg-day)	Child CDI (noncancer)	EPA - RfD (mg/kg-day)	Adult Hazard based on EPA RfD	Child Hazard based on EPA RfD
* N-PROPYLBENZENE	7.56E-03	7.59E-09	none	none	none		1.38E-14	3.22E-14	1.00E-02 ^a	1.38E-12	3.22E-12
* O-XYLENE	1.39E-01	2.34E-06	NC	NC	NC		4.25E-12	9.92E-12	2.00E+00	2.13E-12	4.96E-12
* P-ISOPROPYLTOLUENE	3.91E-02	9.28E-08	none	none	none		1.69E-13	3.94E-13	2.00E-01 ^a	8.44E-13	1.97E-12
* SEC-BUTYLBENZENE	3.04E-02	6.19E-06	none	none	none		1.13E-11	2.63E-11	1.00E-02 ^a	1.13E-09	2.63E-09
* TERT-BUTYLBENZENE	6.30E-03	1.18E-06	none	none	none		2.14E-12	5.00E-12	1.00E-02 ^a	2.14E-10	5.00E-10
TETRACHLOROETHENE	1.00E-03	4.71E-08	none	none	none		8.56E-14	2.00E-13	1.00E-02	8.56E-12	2.00E-11
* TOLUENE	3.78E-02	1.58E-06	NC	NC	NC		2.88E-12	6.71E-12	2.00E-01	1.44E-11	3.36E-11
CHEMICAL CLASS-SPECIFIC RISK =					6.28E-08					2.25E-07	5.25E-07
PCBs ^c											
AROCLOR 1260	2.10E-02	2.40E-12	7.70E+00	2.00E+00	4.81E-12	EPA	4.37E-12	1.02E-11	2.00E-05 ^b	2.19E-07	5.10E-07
CHEMICAL CLASS-SPECIFIC RISK =					4.81E-12					2.18595E-07	5.10055E-07
METALS ^c											
Chromium	2.31E+01	2.65E-09	NA	NA	NA		4.81E-09	1.12E-08	1.50E+00 ^{b,e}	3.21E-09	7.48E-09
Cobalt	2.38E+01	2.73E-09	NA	NA	NA		4.95E-09	1.16E-08	6.00E-02 ^e	8.26E-08	1.93E-07
Molybdenum	1.16E+00	1.33E-10	none	none	none		2.41E-10	5.63E-10	5.00E-03	4.83E-08	1.13E-07
Nickel	2.76E+01	3.15E-09	NA	NA	NA		5.74E-09	1.34E-08	2.00E-02 ^a	2.87E-07	6.69E-07
Vanadium	7.93E+01	9.08E-09	NA	NA	NA		1.65E-08	3.85E-08	7.00E-03 ^e	2.36E-06	5.50E-06
CHEMICAL CLASS-SPECIFIC RISK =					0.00E+00					2.78E-06	6.49E-06
PATHWAY-SPECIFIC RISK =					6.31E-08					4.71E-07	1.10E-06
PATHWAY-SPECIFIC RISK (Petroleum) =					2.61E-08					2.52E-07	5.88E-07
PATHWAY-SPECIFIC RISK (CERCLA-only) =					3.70E-08					2.19E-07	5.10E-07
DERMAL ROUTE											
SVOCs											
* BENZ(A)ANTHRACENE	1.40E-01	9.00E-08	9.00E-01	7.30E-01	6.57E-08	EPA	9.95E-08	6.52E-07	2.00E-02 ^a	4.97E-06	3.26E-05
* Benzo(a)pyrene	1.80E-01	1.16E-07	9.00E+00	7.30E+00	1.04E-06	CA	1.28E-07	8.38E-07	2.00E-02 ^a	6.39E-06	4.19E-05
* BENZO(B)FLUORANTHENE	2.90E-01	1.86E-07	9.00E-01	7.30E-01	1.36E-07	EPA	2.66E-07	1.35E-06	2.00E-02 ^a	1.03E-05	6.75E-05
* BENZO(G,H,I)PERYLENE	8.20E-02	5.27E-08	NC	NC	NC		5.83E-08	3.82E-07	2.00E-02 ^a	2.91E-06	1.91E-05
* CHRYSENE	2.20E-01	1.41E-07	9.00E-02	7.30E-03	1.27E-08	CA	1.56E-07	1.02E-06	2.00E-02 ^a	7.82E-06	5.12E-05
* FLUORANTHENE	2.93E-01	1.90E-07	NC	NC	NC		2.10E-07	1.37E-06	2.00E-02 ^a	1.05E-05	6.87E-05
* INDENO(1,2,3-CD)PYRENE	8.20E-02	5.27E-08	9.00E-01	7.30E-01	3.83E-08	EPA	5.83E-08	3.82E-07	2.00E-02 ^a	2.91E-06	1.91E-05
* 2-METHYLNAPHTHALENE	4.01E-01	2.58E-07	none	none	none		2.85E-07	1.87E-06	2.00E-02 ^a	1.43E-05	9.34E-05
* NAPHTHALENE	5.02E-01	3.23E-07	NC	NC	NC		3.57E-07	2.34E-06	2.00E-02 ^a	1.78E-05	1.17E-04
* PHENANTHRENE	2.00E-01	1.29E-07	NC	NC	NC		1.42E-07	9.31E-07	2.00E-02 ^a	7.11E-06	4.63E-05
* PYRENE	3.70E-01	2.38E-07	NC	NC	NC		2.63E-07	1.72E-06	3.00E-02	8.76E-06	5.74E-05
CHEMICAL CLASS-SPECIFIC RISK =					1.29E-06					9.38E-05	6.14E-04
VOCs											
* 1,2,4-TRIMETHYLBENZENE	8.02E+00	3.97E-06	none	none	none		4.38E-06	2.87E-05	1.00E-02 ^a	4.38E-04	2.87E-03
1,2-DICHLOROETHANE	6.12E-03	3.03E-09	7.00E-02	9.10E-02	2.75E-10	EPA	3.34E-09	2.19E-08	3.00E-02 ^b	1.11E-07	7.30E-07

TABLE L-8
FUTURE RESIDENTIAL SCENARIO FOR ADULT AND CHILD
CANCER RISKS AND TOXICITY HAZARD FROM SUBSURFACE SOIL EXPOSURE
NMCRC-LA

CHEMICAL	EPC (mg/kg)	CDI (cancer) (mg/kg-day)	California CSF (Chronic) (mg/kg-day)-1	EPA - CSF (Chronic) (mg/kg-day)-1	Cancer Risk based on EPA & CA CSF	CSF Used	Adult CDI (noncancer) (mg/kg-day)	Child CDI (noncancer)	EPA - RfD (mg/kg-day)	Adult Hazard based on EPA RfD	Child Hazard based on EPA RfD	
* 1,3,5-TRIMETHYLBENZENE	9.30E-01	4.60E-07	none	none	none		5.08E-07	3.33E-06	1.00E-02	5.08E-05	3.33E-04	
2-BUTANONE (MEK)	7.87E-02	3.89E-08	NC	NC	NC		4.30E-08	2.82E-07	6.00E-01	7.17E-08	4.70E-07	
ACETONE	1.13E-01	5.61E-08	NC	NC	NC		6.20E-08	4.06E-07	1.00E-01	6.20E-07	4.06E-06	
* BENZENE	1.10E-02	5.43E-09	1.88E-02	1.50E-02	8.14E-11	EPA	6.00E-09	3.93E-08	3.00E-03	2.00E-06	1.31E-05	
Carbon disulfide	7.43E-03	3.68E-09	none	none	none		4.06E-09	2.66E-08	1.00E-01	4.06E-08	2.66E-07	
* ETHYLBENZENE	4.27E-01	2.11E-07	NC	NC	NC		2.33E-07	1.53E-06	1.00E-01	2.33E-06	1.53E-05	
* ISOPROPYLBENZENE	6.28E-02	3.10E-08	none	none	none		3.43E-08	2.23E-07	1.00E-02	3.43E-06	2.25E-05	
* M/P-XYLENE	7.74E-01	3.83E-07	NC	NC	NC		4.23E-07	2.77E-06	2.00E+00	2.12E-07	1.39E-06	
METHYLENE CHLORIDE	2.80E-02	1.38E-08	3.50E-03	7.50E-03	1.04E-10	EPA	1.53E-08	1.00E-07	6.00E-02	2.55E-07	1.67E-06	
* NAPHTHALENE	3.43E-01	1.71E-07	NC	NC	NC		1.89E-07	1.24E-06	2.00E-02	9.43E-06	6.18E-05	
* N-BUTYLBENZENE	3.11E-03	1.54E-09	none	none	none		1.70E-09	1.11E-08	1.00E-02	1.70E-07	1.11E-06	
* N-PROPYLBENZENE	7.56E-03	3.74E-09	none	none	none		4.13E-09	2.71E-08	1.00E-02	4.13E-07	2.71E-06	
* O-XYLENE	1.39E-01	6.83E-08	NC	NC	NC		7.57E-08	4.96E-07	2.00E+00	3.79E-08	2.48E-07	
* P-ISOPROPYLTOLUENE	3.91E-02	1.93E-08	none	none	none		2.13E-08	1.40E-07	2.00E-01	1.07E-07	6.99E-07	
* SEC-BUTYLBENZENE	3.04E-02	1.50E-08	none	none	none		1.66E-08	1.09E-07	1.00E-02	1.66E-06	1.09E-05	
* TERT-BUTYLBENZENE	6.30E-03	3.12E-09	none	none	none		3.44E-09	2.26E-08	1.00E-02	3.44E-07	2.26E-06	
TETRACHLOROETHENE	1.00E-03	4.95E-10	none	none	none		5.47E-10	3.58E-09	1.00E-02	5.47E-08	3.58E-07	
* TOLUENE	3.78E-02	1.87E-08	NC	NC	NC		2.07E-08	1.35E-07	2.00E-01	1.03E-07	6.77E-07	
CHEMICAL CLASS-SPECIFIC RISK =					4.60E-10					5.11E-04	3.34E-03	
PCBs												
AROCLOR 1260	2.10E-02	1.43E-08	7.70E+00	2.00E+00	2.91E-08	EPA	1.61E-08	1.05E-07	2.00E-05	8.03E-04	5.26E-03	
CHEMICAL CLASS-SPECIFIC RISK =					2.91E-08					8.03E-04	5.26E-03	
METALS												
Chromium	2.31E+01	1.14E-06	NA	NA	NA		1.26E-06	8.27E-06	1.50E+00	8.42E-07	5.52E-06	
Cobalt	2.38E+01	1.18E-06	NA	NA	NA		1.30E-06	8.52E-06	6.00E-02	2.17E-05	1.42E-04	
Molybdenum	1.16E+00	5.74E-08	none	none	none		6.34E-08	4.15E-07	5.00E-03	1.27E-05	8.31E-05	
Nickel	2.76E+01	1.36E-06	NA	NA	NA		1.51E-06	9.86E-06	2.00E-02	7.53E-05	4.93E-04	
Vanadium	7.93E+01	3.92E-06	NA	NA	NA		4.33E-06	2.84E-05	7.00E-03	6.19E-04	4.06E-03	
CHEMICAL CLASS-SPECIFIC RISK =					0.00E+00					7.30E-04	4.78E-03	
PATHWAY-SPECIFIC RISK =					1.32E-06					2.14E-03	1.40E-02	
PATHWAY-SPECIFIC RISK (Petroleum) =					1.29E-06					6.03E-04	3.95E-03	
PATHWAY-SPECIFIC RISK (CERCLA-only) =					2.95E-08					1.53E-03	1.00E-02	
TOTAL CUMULATIVE TOXICITY HAZARD =											2.11E-02	1.91E-01
TOTAL CANCER RISKS =											4.60E-06	1.03E-02
TOTAL: Petroleum-related: CERCLA-only:											1.28E-03	1.81E-01
											1.98E-02	1.81E-01

TABLE L-8
FUTURE RESIDENTIAL SCENARIO FOR ADULT AND CHILD
CANCER RISKS AND TOXICITY HAZARD FROM SUBSURFACE SOIL EXPOSURE
NMCRC-LA

CHEMICAL	EPC (mg/kg)	CDI (cancer) (mg/kg-day)	California CSF (Chronic) (mg/kg-day) ⁻¹	EPA - CSF (Chronic) (mg/kg-day) ⁻¹	Cancer Risk based on EPA & CA CSF	CSF Used	Adult CDI (noncancer) (mg/kg-day)	Child CDI (noncancer)	EPA - RID (mg/kg-day)	Adult Hazard based on EPA RID	Child Hazard based on EPA RID
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* = Petroleum-related chemical
CPF = Cancer Potency Factor
CDI = Chronic daily intake
mg/kg-day = milligrams per kilogram per day
EPC = Exposure Point Concentration
NA = Not Available
NC = Not a known carcinogen
NMCRC-LA= Naval and Marine Corps Reserve Center- Los Angeles
RID = Reference Dose
a= No RID located. Surrogate toxicity value used based on structure relationship
b = Surrogate toxicity value used based on EPA Region IX PRG Table, 1999.
c = Chemicals having a Henry's Law Constant below 10⁻³ and a molecular weight greater than 200 g/mol.
d = Chemicals having a Henry's Law Constant greater than 10⁻⁵ and a molecular weight less than 200 g/mol.
e = Toxicity criteria from EPA Region 9 Preliminary Remediation Goals 1999
f = If a CPF was available from the U.S. EPA but not from the California EPA, the EPA CPF was used in California EPA calculations.

TABLE L-9
Future Residential Scenario for Adult and Child
Cancer Risks and Toxicity Hazard from Exposure to Groundwater
NMCRC-LA

CHEMICAL	EPC (mg/l)	CalCSF (Chronic) (mg/kg-day) ⁻¹	EPA CSF (Chronic) (mg/kg-day) ⁻¹	Cancer Risk Based On EPA & CA CSF	CSF Used	CDI ^(b) Child (noncancer) (mg/kg-day)	CDI ^(b) Adult (noncancer) (mg/kg-day)	Reference Dose (mg/kg-day)	Systemic Risk to Children	Systemic Risk to Adults
GROUNDWATER INGESTION ROUTE										
SVOCs										
DI-N-BUTYLPHTHALATE	8.71E-03	NA	NA	NA		5.57E-04	2.39E-04	1.00E-01	^(c) 5.57E-03	2.39E-03
* 2-METHYLNAPHTHALENE	1.11E-02	NA	NA	NA		7.08E-04	3.03E-04	2.00E-02	^(b) 3.54E-02	1.52E-02
* NAPHTHALENE	2.37E-02	NA	NA	NA		1.52E-03	6.51E-04	2.00E-02	^(c) 7.59E-02	3.25E-02
CHEMICAL CLASS-SPECIFIC RISK =										
				0.00E+00					0.12	0.05
VOCs										
* 1,2,4-TRIMETHYLBENZENE	7.42E-02	NA	NA	NA		4.74E-03	2.03E-03	5.00E-02	^(d) 9.49E-02	4.07E-02
1,2-DICHLOROETHANE	1.33E-02	7.00E-02	9.10E-02	1.80E-05	EPA	8.51E-04	3.65E-04	3.00E-02	^(d) 2.84E-02	1.22E-02
* 1,3,5-TRIMETHYLBENZENE	1.82E-02	NA	NA	NA		1.17E-03	5.00E-04	5.00E-02	^(d) 2.33E-02	9.99E-03
* BENZENE	3.78E-02	1.00E-01	2.90E-02	1.63E-05	EPA	2.42E-03	1.04E-03	3.00E-03	^(d) 8.05E-01	3.45E-01
CARBON DISULFIDE	1.00E-03	NA	NA	NA		6.39E-05	2.74E-05	1.00E-01	^(c) 6.39E-04	2.74E-04
CHLOROFORM	4.03E-03	3.10E-02	6.10E-03	3.66E-07	EPA	2.58E-04	1.10E-04	1.00E-02	^(c) 2.58E-02	1.10E-02
* ETHYLBENZENE	2.26E-02	NA	NA	NA		1.44E-03	6.19E-04	1.00E-01	^(c) 1.44E-02	6.19E-03
* ISOPROPYLBENZENE	7.35E-03	NA	NA	NA		4.70E-04	2.01E-04	1.00E-01	^(c) 4.70E-03	2.01E-03
* M/P-XYLENE	4.10E-02	NA	NA	NA		2.62E-03	1.12E-03	2.00E+00	^(c) 1.31E-03	5.61E-04
* NAPHTHALENE	1.31E-02	NA	NA	NA		8.39E-04	3.60E-04	2.00E-02	^(c) 4.19E-02	1.80E-02
* N-PROPYLBENZENE	1.82E-02	NA	NA	NA		1.17E-03	4.99E-04	1.00E-02	^(d) 1.17E-01	4.99E-02
* O-XYLENE	1.74E-02	NA	NA	NA		1.11E-03	4.77E-04	2.00E+00	^(c) 5.56E-04	2.38E-04
* P-ISOPROPYLTOLUENE	3.87E-03	NA	NA	NA		2.47E-04	1.06E-04	NA	NA	NA
* SEC-BUTYLBENZENE	4.09E-03	NA	NA	NA		2.61E-04	1.12E-04	1.00E-02	^(d) 2.61E-02	1.12E-02
* TERT-BUTYLBENZENE	1.00E-03	NA	NA	NA		6.39E-05	2.74E-05	1.00E-02	^(d) 6.39E-03	2.74E-03
TETRACHLOROETHENE	2.00E-03	5.10E-02	5.20E-02	1.52E-06	CA	1.28E-04	5.48E-05	1.00E-02	^(c) 1.28E-02	5.48E-03
* TOLUENE	1.60E-02	NA	NA	NA		1.02E-03	4.38E-04	2.00E-01	^(c) 5.11E-03	2.19E-03
CHEMICAL CLASS-SPECIFIC RISK =										
				3.62E-05					1.21	0.52
METALS										
Barium	1.77E-01	N/C	N/C	N/C		1.13E-02	4.85E-03	7.00E-02	1.62E-01	6.93E-02
Cobalt	8.86E-03	NA	NA	NA		5.66E-04	2.43E-04	6.00E-02	^(e) 9.44E-03	4.05E-03
Lead	1.44E-03	NA	NA ^d	NA		9.19E-05	3.94E-05	NA	NA	NA
Nickel	1.65E-02	NA	NA	NA		1.06E-03	4.53E-04	2.00E-02	^(e) 5.28E-02	2.26E-02
Molybdenum	9.24E-02	none	none	none		5.91E-03	2.53E-03	5.00E-03	1.18E+00	5.06E-01
Antimony	5.80E-03	NA	NA	NA		3.70E-04	1.59E-04	4.00E-04	9.26E-01	3.97E-01
Zinc	1.90E-02	NA	NA	NA		1.22E-03	5.21E-04	3.00E-01	4.05E-03	1.74E-03

TABLE L-9
Future Residential Scenario for Adult and Child
Cancer Risks and Toxicity Hazard from Exposure to Groundwater
NMCRC-LA

CHEMICAL	EPC (mg/l)	CDI (cancer) (mg/kg-day)	CalCSF (Chronic) (mg/kg-day) ⁻¹	EPA CSF (Chronic) (mg/kg-day) ⁻¹	Cancer Risk Based On EPA & CA CSF	CSF Used	CDI ^(b) Child (noncancer) (mg/kg-day)	CDI ^(b) Adult (noncancer) (mg/kg-day)	Reference Dose (mg/kg-day)	Systemic Risk to Children	Systemic Risk to Adults
CHEMICAL CLASS-SPECIFIC RISK =											
					0.00E+00					2.3	1.0
PATHWAY-SPECIFIC RISK =											
PATHWAY-SPECIFIC RISK (Petroleum) =					3.62E-05					3.7	1.6
PATHWAY-SPECIFIC RISK (CERCLA-only) =					1.63E-05					1.3	0.5
					1.99E-05					2.4	1.0
INHALATION ROUTE - Vapors											
SVOCs											
DI-N-BUTYLPHthalATE	8.71E-03	1.55E-05	NA	NA	NA		9.74E-05	2.09E-05	1.00E-01	(e) 9.74E-04	2.09E-04
* 2-METHYLNAPhtHALENE	1.11E-02	1.97E-05	NA	NA	NA		1.24E-04	2.65E-05	NA	NA	NA
* NAPhtHALENE	2.37E-02	4.23E-05	NA	NA	NA		2.66E-04	5.69E-05	8.60E-04	(e) 3.09E-01	6.62E-02
CHEMICAL CLASS-SPECIFIC RISK =					0.00E+00					0.31	0.07
POCs											
* 1,2,4-TRIMETHYLBENZENE	7.42E-02	1.32E-04	NA	NA	NA		8.30E-04	1.78E-04	1.70E-03	(e) 4.88E-01	1.05E-01
1,2-DICHLOROETHANE	1.33E-02	2.37E-05	7.00E-02	9.10E-02	2.16E-06	EPA	1.49E-04	3.19E-05	1.40E-03	(e) 1.06E-01	2.28E-02
* 1,3,5-TRIMETHYLBENZENE	1.82E-02	3.25E-05	NA	NA	NA		2.04E-04	4.37E-05	1.70E-03	(e) 1.20E-01	2.57E-02
* BENZENE	2.78E-02	6.73E-05	1.00E-01	2.70E-02	1.82E-06	EPA	4.23E-04	9.06E-05	1.70E-03	(e) 2.49E-01	5.33E-02
CARBON DISULFIDE	1.00E-03	1.78E-06	NA	NA	NA		1.12E-05	2.40E-06	2.00E-01	(e) 5.59E-05	1.20E-05
CHLOROFORM	4.03E-03	7.17E-06	1.90E-02	8.10E-02	5.81E-07	EPA	4.51E-05	9.66E-06	8.60E-05	(e) 5.24E-01	1.12E-01
* ETHYLBENZENE	2.26E-02	4.02E-05	NA	NA	NA		2.53E-04	5.42E-05	2.90E-01	(e) 8.71E-04	1.87E-04
* ISOPROPYLBENZENE	7.35E-03	1.31E-05	NA	NA	NA		8.22E-05	1.76E-05	1.10E-01	(e) 7.47E-04	1.60E-04
* M/P-XYLENE	4.10E-02	7.30E-05	NA	NA	NA		4.58E-04	9.82E-05	NA	NA	NA
* NAPhtHALENE	1.31E-02	2.34E-05	NA	NA	NA		1.47E-04	3.15E-05	8.60E-04	(e) 1.71E-01	3.66E-02
* N-PROPYLBENZENE	1.82E-02	3.25E-05	NA	NA	NA		2.04E-04	4.37E-05	1.00E-02	(e) 2.04E-02	4.37E-03
* O-XYLENE	1.74E-02	3.10E-05	NA	NA	NA		1.95E-04	4.17E-05	NA	NA	NA
* P-ISOPROPYLTOLUENE	3.87E-03	6.89E-06	NA	NA	NA		4.33E-05	9.27E-06	NA	NA	NA
* SEC-BUTYLBENZENE	4.09E-03	7.28E-06	NA	NA	NA		4.58E-05	9.80E-06	1.00E-02	(e) 4.58E-03	9.80E-04
* TERT-BUTYLBENZENE	1.00E-03	1.78E-06	NA	NA	NA		1.12E-05	2.40E-06	1.00E-02	(e) 1.12E-03	2.40E-04
TETRACHLOROETHENE	2.00E-03	3.56E-06	2.10E-02	2.00E-03	7.48E-08	CA	2.24E-05	4.79E-06	1.10E-01	(e) 2.03E-04	4.36E-05
* TOLUENE	1.60E-02	2.84E-05	NA	NA	NA		1.79E-04	3.83E-05	1.10E-01	(e) 1.62E-03	3.48E-04
CHEMICAL CLASS-SPECIFIC RISK =					4.63E-06					1.69	0.36
PATHWAY-SPECIFIC RISK =											
					4.63E-06					2.00	0.43

TABLE L-9
Future Residential Scenario for Adult and Child
Cancer Risks and Toxicity Hazard from Exposure to Groundwater
NMCRC-LA

CHEMICAL	EPC (mg/l)	CDI (cancer) (mg/kg-day)	CalCSF (Chronic) (mg/kg-day) ⁻¹	EPA CSF (Chronic) (mg/kg-day) ⁻¹	Cancer Risk Based On EPA & CA CSF	CSF Used	CDI ^(b) Child (noncancer) (mg/kg-day)	CDI ^(b) Adult (noncancer) (mg/kg-day)	Reference Dose (mg/kg-day)	Systemic Risk to Children	Systemic Risk to Adults
PATHWAY-SPECIFIC RISK (Petroleum) =											
PATHWAY-SPECIFIC RISK (CERCLA-only) =											
					1.82E-06					1.37	0.29
					2.81E-06					0.63	0.14
DERMAL ABSORPTION FROM SHOWER											
SPOCs											
DI-N-BUTYLPHTHALATE	8.71E-03	6.35E-07	NA	NA	NA		2.28E-06	1.28E-06	1.00E-01	(e) 2.28E-05	1.28E-05
* 2-METHYLNAPHTHALENE	1.11E-02	6.96E-05	NA	NA	NA		2.50E-04	1.40E-04	2.00E-02	(d) 1.25E-02	7.02E-03
* NAPHTHALENE	2.37E-02	1.49E-04	NA	NA	NA		5.37E-04	3.01E-04	2.00E-02	(e) 2.69E-02	1.51E-02
CHEMICAL CLASS-SPECIFIC RISK =					0.00E+00					3.94E-02	2.21E-02
VOCs											
* 1,2,4-TRIMETHYLBENZENE	7.42E-02	4.60E-06	NA	NA	NA		1.65E-05	9.28E-06	5.00E-02	(g) 3.31E-04	1.86E-04
1,2-DICHLOROETHANE	1.33E-02	6.43E-06	7.00E-02	9.10E-02	5.85E-07	EPA	2.31E-05	1.30E-05	3.00E-02	(g) 7.71E-04	4.32E-04
* 1,3,5-TRIMETHYLBENZENE	1.82E-02	1.13E-06	NA	NA	NA		4.06E-06	2.28E-06	5.00E-02	(g) 8.13E-05	4.56E-05
* BENZENE	3.78E-02	7.23E-05	1.00E-01	2.90E-02	2.10E-06	EPA	1.10E-04	6.18E-05	3.00E-03	(g) 3.67E-02	2.06E-02
CARBON DISULFIDE	1.00E-03	6.29E-06	NA	NA	NA		2.62E-07	1.47E-07	1.00E-01	(e) 2.62E-06	1.47E-06
CHLOROFORM	4.03E-03	3.27E-06	3.10E-02	6.10E-03	1.99E-08	EPA	2.77E-05	1.56E-05	1.00E-02	(e) 2.77E-03	1.56E-03
* ETHYLBENZENE	2.26E-02	1.52E-04	NA	NA	NA		5.48E-04	3.07E-04	1.00E-01	(e) 5.48E-03	3.07E-03
* ISOPROPYLBENZENE	7.35E-03	5.96E-07	NA	NA	NA		2.14E-06	1.20E-06	1.00E-01	(e) 2.14E-05	1.20E-05
* M/P-XYLENE	4.10E-02	2.99E-04	NA	NA	NA		1.07E-03	6.02E-04	2.00E+00	(e) 5.37E-04	3.01E-04
* NAPHTHALENE	1.31E-02	8.25E-05	NA	NA	NA		2.97E-04	1.66E-04	2.00E-02	(e) 1.48E-02	8.32E-03
* N-PROPYLBENZENE	1.82E-02	1.15E-05	NA	NA	NA		4.12E-05	2.31E-05	1.00E-02	(g) 4.12E-03	2.31E-03
* O-XYLENE	1.74E-02	1.27E-04	NA	NA	NA		4.56E-04	2.56E-04	2.00E+00	(e) 2.28E-04	1.28E-04
* P-ISOPROPYLTOLUENE	3.87E-03	3.14E-07	NA	NA	NA		1.13E-06	6.33E-07	NA	NA	NA
* SEC-BUTYLBENZENE	4.09E-03	2.98E-07	NA	NA	NA		1.07E-06	6.01E-07	1.00E-02	(g) 1.07E-04	6.01E-05
* TERT-BUTYLBENZENE	1.00E-03	7.29E-08	NA	NA	NA		2.62E-07	1.47E-07	1.00E-02	(g) 2.62E-05	1.47E-05
TETRACHLOROETHENE	2.00E-03	6.74E-05	5.10E-02	5.20E-02	3.44E-06	CA	2.43E-04	1.36E-04	1.00E-02	(e) 2.43E-02	1.36E-02
* TOLUENE	1.60E-02	6.55E-05	NA	NA	NA		2.36E-04	1.32E-04	2.00E-01	(e) 1.18E-03	6.61E-04
CHEMICAL CLASS-SPECIFIC RISK =					6.14E-06					0.09	0.05
METALS											
Barium	1.77E-01	7.25E-04	N/C	N/C	N/C		5.80E-05	3.25E-05	7.00E-02	8.29E-04	4.65E-04
Cobalt	8.86E-03	3.63E-05	NA	NA	NA		2.90E-06	1.63E-06	6.00E-02	(e) 4.84E-05	2.71E-05
Lead	1.44E-03	5.89E-06	NA	NA ^d	NA		4.71E-07	2.64E-07	NA	NA	NA
Nickel	1.65E-02	6.78E-05	NA	NA	NA		5.42E-06	3.04E-06	2.00E-02	(e) 2.71E-04	1.52E-04

TABLE L-9
Future Residential Scenario for Adult and Child
Cancer Risks and Toxicity Hazard from Exposure to Groundwater
NMCRC-LA

CHEMICAL	EPC (mg/l)	CDI (cancer) (mg/kg-day)	CalCSF (Chronic) (mg/kg-day) ⁻¹	EPA CSF (Chronic) (mg/kg-day) ⁻¹	Cancer Risk Based On EPA & CA CSF	CSF Used	CDI ^(b) Child (noncancer) (mg/kg-day)	CDI ^(b) Adult (noncancer) (mg/kg-day)	Reference Dose (mg/kg-day)	Systemic Risk to Children	Systemic Risk to Adults
Molivbdenum	9.24E-02	3.79E-04	none	none	none		3.03E-05	1.70E-05	5.00E-03	6.06E-03	3.40E-03
Antimony	5.80E-03	2.38E-05	NA	NA	NA		1.90E-06	1.07E-06	4.00E-04	4.75E-03	2.66E-03
Zinc	1.90E-02	7.79E-05	NA	NA	NA		6.23E-06	3.49E-06	3.00E-01	2.08E-05	1.16E-05
CHEMICAL CLASS-SPECIFIC RISK =					0.00E+00					0.01	0.01
PATHWAY-SPECIFIC RISK =					6.14E-06					0.14	0.08
PATHWAY-SPECIFIC RISK (Petroleum) =					2.10E-06					0.10	0.06
PATHWAY-SPECIFIC RISK (CERCLA-only) =					4.04E-06					0.04	0.02
TOTAL:				TOTAL CANCER RISK =	4.70E-05				CUMULATIV E TOXICITY HAZARD =	5.80	2.08
Petroleum-related:					2.02E-05				TOXICITY	2.72	0.89
CERCLA-only:					2.68E-05				TOXICITY	3.08	1.19

* = Petroleum-related chemical

- (b) = CDI values not adjusted
(c) = Integrated Risk Information System
(d) = The EPA does not recommend applying a CSF to lead to substantial uncertainty in epidemiological data
(e) = Surrogate toxicity value used based on EPA Region IX PRG Table, October 1999.
(f)= Health Effects Assessment Summary Tables
(g) = Toxicity criteria from EPA Region IX Preliminary Remediation Goals, October 1999
CSF = Cancer Slope Factor
CDI = Chronic daily intake
mg/kg-day = milligrams per kilogram per day
EPC = Exposure Point Concentration
NA = Not Available
NC= not a known carcinogen
NMCRC-LA= Naval and Marine Corps Reserve Center- Los Angeles
RfD = Reference Dose

TABLE L-10
Future Residential Scenario for Adult and Child Based on Groundwater Modeled Data
Cancer Risks and Toxicity Hazard from Exposure to Modeled Groundwater Chemical Concentrations
NMCRC-LA

CHEMICAL	EPC (mg/l)	CDI (cancer) (mg/kg-day)	CalCSF (Chronic) (mg/kg-day) ⁻¹	EPA CSF (Chronic) (mg/kg-day) ⁻¹	Cancer Risk Based On EPA & CA CSF Used	CSF	CDI ^a Child (noncancer) (mg/kg-day)	CDI ^a Adult (noncancer) (mg/kg-day)	Reference Dose (mg/kg-day)	Systemic Risk to Children	Systemic Risk to Adults
GROUNDWATER INGESTION ROUTE											
SVOCs											
DI-N-BUTYLPHTHALATE	8.71E-03	1.30E-04	NA	NA	NA		5.57E-04	2.39E-04	1.00E-01	(e) 5.57E-03	2.39E-03
* 2-METHYLNAPHTHALENE	1.11E-02	1.65E-04	NA	NA	NA		7.08E-04	3.03E-04	2.00E-02	(d) 3.54E-02	1.52E-02
* NAPHTHALENE	2.37E-02	3.53E-04	NA	NA	NA		1.52E-03	6.51E-04	2.00E-02	(e) 7.59E-02	3.25E-02
CHEMICAL CLASS-SPECIFIC RISK =											
0.00E+00											
VOCs											
* 1,2,4-TRIMETHYLBENZENE	2.03E-02	3.02E-04	NA	NA	NA		1.30E-03	5.56E-04	5.00E-02	(e) 2.60E-02	1.11E-02
1,2-DICHLOROETHANE	1.00E-03	1.49E-05	7.00E-02	9.10E-02	1.35E-06	EPA	6.39E-05	2.74E-05	3.00E-02	(e) 2.13E-03	9.13E-04
* 1,3,5-TRIMETHYLBENZENE	5.70E-03	8.48E-05	NA	NA	NA		3.64E-04	1.56E-04	5.00E-02	(e) 7.29E-03	3.12E-03
* BENZENE	4.00E-03	5.95E-05	1.00E-01	2.90E-02	1.73E-06	EPA	2.56E-04	1.10E-04	3.00E-03	(e) 8.52E-02	3.65E-02
CARBON DISULFIDE	1.00E-03	1.49E-05	NA	NA	NA		6.39E-05	2.74E-05	1.00E-01	(e) 6.39E-04	2.74E-04
CHLOROFORM	4.03E-03	5.99E-05	3.10E-02	6.10E-03	3.66E-07	EPA	2.58E-04	1.10E-04	1.00E-02	(e) 2.58E-02	1.10E-02
* ETHYLBENZENE	2.26E-02	3.36E-04	NA	NA	NA		1.44E-03	6.19E-04	1.00E-01	(e) 1.44E-02	6.19E-03
* ISOPROPYLBENZENE	7.35E-03	1.09E-04	NA	NA	NA		4.70E-04	2.01E-04	1.00E-01	(e) 4.70E-03	2.01E-03
* M/P-XYLENE	4.10E-02	6.09E-04	NA	NA	NA		2.62E-03	1.12E-03	2.00E+00	(e) 1.31E-03	5.61E-04
* NAPHTHALENE	1.31E-02	1.95E-04	NA	NA	NA		8.39E-04	3.60E-04	2.00E-02	(e) 4.19E-02	1.80E-02
* N-PROPYLBENZENE	1.82E-02	2.71E-04	NA	NA	NA		1.17E-03	4.99E-04	1.00E-02	(e) 1.17E-01	4.99E-02
* O-XYLENE	1.74E-02	2.59E-04	NA	NA	NA		1.11E-03	4.77E-04	2.00E+00	(e) 5.56E-04	2.38E-04
* P-ISOPROPYLTOLUENE	3.87E-03	5.75E-05	NA	NA	NA		2.47E-04	1.06E-04	NA	NA	NA
* SEC-BUTYLBENZENE	4.09E-03	6.08E-05	NA	NA	NA		2.61E-04	1.12E-04	1.00E-02	(e) 2.61E-02	1.12E-02
* TERT-BUTYLBENZENE	1.00E-03	1.49E-05	NA	NA	NA		6.39E-05	2.74E-05	1.00E-02	(e) 6.39E-03	2.74E-03
TETRACHLOROETHENE	2.00E-03	2.97E-05	5.10E-02	5.20E-02	1.52E-06	CA	1.28E-04	5.48E-05	1.00E-02	(e) 1.28E-02	5.48E-03
* TOLUENE	1.60E-02	2.38E-04	NA	NA	NA		1.02E-03	4.38E-04	2.00E-01	(e) 5.11E-03	2.19E-03
CHEMICAL CLASS-SPECIFIC RISK =											
4.96E-06											
METALS											
Barium	1.77E-01	2.63E-03	N/C	N/C	N/C		1.13E-02	4.85E-03	7.00E-02	1.62E-01	6.93E-02
Cobalt	8.86E-03	1.32E-04	NA	NA	NA		5.66E-04	2.43E-04	6.00E-02	(e) 9.44E-03	4.05E-03
Lead	1.44E-03	2.14E-05	NA	NA ^d	NA		9.19E-05	3.94E-05	NA	NA	NA
Nickel	1.65E-02	2.46E-04	NA	NA	NA		1.06E-03	4.53E-04	2.00E-02	(e) 5.28E-02	2.26E-02
Molybdenum	9.24E-02	1.37E-03	none	none	none		5.91E-03	2.53E-03	5.00E-03	1.18E+00	5.06E-01
Antimony	5.80E-03	8.62E-05	NA	NA	NA		3.70E-04	1.59E-04	4.80E-04	9.26E-01	3.97E-01
Zinc	1.90E-02	2.83E-04	NA	NA	NA		1.22E-03	5.21E-04	3.00E-01	4.05E-03	1.74E-03

TABLE L-10
Future Residential Scenario for Adult and Child Based on Groundwater Modeled Data
Cancer Risks and Toxicity Hazard from Exposure to Modeled Groundwater Chemical Concentrations
NMCRC-LA

a	EPC (mg/l)	CDI (cancer) (mg/kg-day)	CalCSF (Chronic) (mg/kg-day) ⁻¹	EPA CSF (Chronic) (mg/kg-day) ⁻¹	Cancer Risk Based On EPA & CA CSF Used	CSF	CDI* Child (noncancer) (mg/kg-day)	CDI* Adult (noncancer) (mg/kg-day)	Reference Dose (mg/kg-day)	Systemic Risk to Children	Systemic Risk to Adults
CHEMICAL CLASS-SPECIFIC RISK =											2.31.0
0.00E+00											
PATHWAY-SPECIFIC RISK =											2.81.2
4.96E-06											
PATHWAY-SPECIFIC RISK (Petroleum) =											0.40.2
1.73E-06											
PATHWAY-SPECIFIC RISK (CERCLA-only) =											2.41.0
3.24E-06											
INHALATION ROUTE - Vapors											
SVOCs											
DI-N-BUTYLPHTHALATE	8.71E-03	1.55E-05	NA	NA	NA		9.74E-05	2.09E-05	1.00E-01	9.74E-04	2.09E-04
* 2-METHYLNAPHTHALENE	1.11E-02	1.97E-05	NA	NA	NA		1.24E-04	2.65E-05	NA	NA	NA
* NAPHTHALENE	2.37E-02	4.23E-05	NA	NA	NA		2.66E-04	5.69E-05	8.60E-04	3.09E-01	6.62E-02
CHEMICAL CLASS-SPECIFIC RISK =											0.310.07
0.00E+00											
VOCs											
* 1,2,4-TRIMETHYLBENZENE	2.03E-02	3.62E-05	NA	NA	NA		2.27E-04	4.87E-05	1.70E-03	1.34E-01	2.86E-02
1,2-DICHLOROETHANE	1.00E-03	1.78E-06	7.00E-02	9.10E-02	1.62E-07	EPA	1.12E-05	2.40E-06	1.40E-03	7.99E-03	1.71E-03
* 1,3,5-TRIMETHYLBENZENE	5.70E-03	1.02E-05	NA	NA	NA		6.38E-05	1.37E-05	1.70E-03	3.75E-02	8.04E-03
* BENZENE	4.00E-03	7.12E-06	1.00E-01	2.70E-02	1.92E-07	EPA	4.47E-05	9.59E-06	1.70E-03	2.63E-02	5.64E-03
CARBON DISULFIDE	1.00E-03	1.78E-06	NA	NA	NA		1.12E-05	2.40E-06	2.00E-01	5.59E-05	1.20E-05
CHLOROFORM	4.03E-03	7.17E-06	1.90E-02	8.10E-02	5.81E-07	EPA	4.51E-05	9.66E-06	8.60E-05	5.24E-01	1.12E-01
* ETHYLBENZENE	2.26E-02	4.02E-05	NA	NA	NA		2.53E-04	5.42E-05	2.90E-01	8.71E-04	1.87E-04
* ISOPROPYLBENZENE	7.35E-03	1.31E-05	NA	NA	NA		8.22E-05	1.76E-05	1.10E-01	7.47E-04	1.60E-04
* M/P-XYLENE	4.10E-02	7.30E-05	NA	NA	NA		4.58E-04	9.82E-05	NA	NA	NA
* NAPHTHALENE	1.31E-02	2.34E-05	NA	NA	NA		1.47E-04	3.15E-05	8.60E-04	1.71E-01	3.66E-02
* N-PROPYLBENZENE	1.82E-02	3.25E-05	NA	NA	NA		2.04E-04	4.37E-05	1.00E-02	2.04E-02	4.37E-03
* O-XYLENE	1.74E-02	3.10E-05	NA	NA	NA		1.95E-04	4.17E-05	NA	NA	NA
* P-ISOPROPYLTOLUENE	3.87E-03	6.89E-06	NA	NA	NA		4.33E-05	9.27E-06	NA	NA	NA
* SEC-BUTYLBENZENE	4.09E-03	7.28E-06	NA	NA	NA		4.58E-05	9.80E-06	1.00E-02	4.58E-03	9.80E-04
* TERT-BUTYLBENZENE	1.00E-03	1.78E-06	NA	NA	NA		1.12E-05	2.40E-06	1.00E-02	1.12E-03	2.40E-04
TETRACHLOROETHENE	2.00E-03	3.56E-06	2.10E-02	2.00E-03	7.48E-08	CA	2.24E-05	4.79E-06	1.10E-01	2.03E-04	4.36E-05
* TOLUENE	1.60E-02	2.84E-05	NA	NA	NA		1.79E-04	3.83E-05	1.10E-01	1.62E-03	3.48E-04
CHEMICAL CLASS-SPECIFIC RISK =											0.930.20
1.01E-06											
PATHWAY-SPECIFIC RISK =											1.240.27
1.01E-06											

TABLE L-10
Future Residential Scenario for Adult and Child Based on Groundwater Modeled Data
Cancer Risks and Toxicity Hazard from Exposure to Modeled Groundwater Chemical Concentrations
NMCRC-LA

CHEMICAL	EPC (mg/l)	CDI (cancer) (mg/kg-day)	CalCSF (Chronic) (mg/kg-day) ⁻¹	EPA CSF (Chronic) (mg/kg-day) ⁻¹	Cancer Risk Based On EPA & CA CSF Used	CDI ^a Child (noncancer) (mg/kg-day)	CDI ^a Adult (noncancer) (mg/kg-day)	Reference Dose (mg/kg-day)	Systemic Risk to Children	Systemic Risk to Adults
PATHWAY-SPECIFIC RISK (Petroleum) =										
PATHWAY-SPECIFIC RISK (CERCLA-only) =										
DERMAL ABSORPTION FROM SHOWER										
SVOCs										
DI-N-BUTYLPHTHALATE	8.71E-03	6.35E-07	NA	NA	NA	2.28E-06	1.28E-06	1.00E-01	(c) 2.28E-05	1.28E-05
* 2-METHYLNAPHTHALENE	1.11E-02	6.96E-05	NA	NA	NA	2.50E-04	1.40E-04	2.00E-02	(d) 1.23E-02	7.02E-03
* NAPHTHALENE	2.37E-02	1.49E-04	NA	NA	NA	5.37E-04	3.01E-04	2.00E-02	(e) 2.69E-02	1.51E-02
CHEMICAL CLASS-SPECIFIC RISK =										
VOCs										
* 1,2,4-TRIMETHYLBENZENE	2.03E-02	1.26E-06	NA	NA	NA	4.52E-06	2.54E-06	5.00E-02	(f) 9.03E-05	5.07E-05
1,2-DICHLOROETHANE	1.00E-03	4.83E-07	7.00E-02	9.10E-02	4.39E-08	1.74E-06	9.74E-07	3.00E-02	(g) 5.79E-05	3.25E-05
* 1,3,5-TRIMETHYLBENZENE	5.70E-03	3.53E-07	NA	NA	NA	1.27E-06	7.12E-07	5.00E-02	(h) 2.54E-05	1.42E-05
* BENZENE	4.00E-03	7.65E-06	1.00E-01	2.90E-02	2.22E-07	1.17E-05	6.54E-06	3.00E-03	(i) 3.89E-03	2.18E-03
CARBON DISULFIDE	1.00E-03	6.29E-06	NA	NA	NA	2.62E-07	1.47E-07	1.00E-01	(j) 2.62E-06	1.47E-06
CHLOROFORM	4.03E-03	3.27E-06	3.10E-02	6.10E-03	1.99E-08	2.77E-05	1.56E-05	1.00E-02	(k) 2.77E-03	1.56E-03
* ETHYLBENZENE	2.26E-02	1.52E-04	NA	NA	NA	5.48E-04	3.07E-04	1.00E-01	(l) 5.48E-03	3.07E-03
* ISOPROPYLBENZENE	7.33E-03	5.96E-07	NA	NA	NA	2.14E-06	1.20E-06	1.00E-01	(m) 2.14E-05	1.20E-05
* M/P-XYLENE	4.10E-02	2.99E-04	NA	NA	NA	1.07E-03	6.02E-04	2.00E+00	(n) 5.37E-04	3.01E-04
* NAPHTHALENE	1.31E-02	8.23E-05	NA	NA	NA	2.97E-04	1.66E-04	2.00E-02	(o) 1.48E-02	8.32E-03
* N-PROPYLBENZENE	1.82E-02	1.15E-05	NA	NA	NA	4.12E-05	2.31E-05	1.00E-02	(p) 4.12E-03	2.31E-03
* O-XYLENE	1.74E-02	1.27E-04	NA	NA	NA	4.56E-04	2.56E-04	2.00E+00	(q) 2.28E-04	1.28E-04
* P-ISOPROPYLTOLUENE	3.87E-03	3.14E-07	NA	NA	NA	1.13E-06	6.33E-07	NA	NA	NA
* SEC-BUTYLBENZENE	4.09E-03	2.98E-07	NA	NA	NA	1.07E-06	6.01E-07	1.00E-02	(r) 1.07E-04	6.01E-05
* TERT-BUTYLBENZENE	1.00E-03	7.29E-08	NA	NA	NA	2.62E-07	1.47E-07	1.00E-02	(s) 2.62E-05	1.47E-05
TETRACHLOROETHENE	2.00E-03	6.74E-05	5.10E-02	5.20E-02	3.44E-06	2.43E-04	1.36E-04	1.00E-02	(t) 2.43E-02	1.36E-02
* TOLUENE	1.60E-02	6.55E-05	NA	NA	NA	2.36E-04	1.32E-04	2.00E-01	(u) 1.18E-03	6.61E-04
CHEMICAL CLASS-SPECIFIC RISK =										
METALS										
Barium	1.77E-01	7.25E-04	N/C	N/C	N/C	5.80E-05	3.25E-05	7.00E-02	8.29E-04	4.65E-04
Cobalt	8.86E-03	3.63E-05	NA	NA	NA	2.90E-06	1.63E-06	6.00E-02	(v) 4.84E-05	2.71E-05
Lead	1.44E-03	5.89E-06	NA	NA ^d	NA	4.71E-07	2.64E-07	NA	NA	NA
Nickel	1.65E-02	6.78E-05	NA	NA	NA	5.42E-06	3.04E-06	2.00E-02	(w) 2.71E-04	1.52E-04

TABLE L-10
Future Residential Scenario for Adult and Child Based on Groundwater Modeled Data
Cancer Risks and Toxicity Hazard from Exposure to Modeled Groundwater Chemical Concentrations
NMCRC-LA

CHEMICAL	EPC (mg/l)	CDI (cancer) (mg/kg-day)	CalCSF (Chronic) (mg/kg-day) ⁻¹	EPA CSF (Chronic) (mg/kg-day) ⁻¹	Cancer Risk Based On EPA & CA CSF Used	CDI ^c Child (noncancer) (mg/kg-day)	CDI ^c Adult (noncancer) (mg/kg-day)	Reference Dose (mg/kg-day)	Systemic Risk to Children	Systemic Risk to Adults
Molybdenum	9.24E-02	3.79E-04	none	none	none	3.03E-05	1.70E-05	5.00E-03	6.06E-03	3.40E-03
Antimony	5.80E-03	2.38E-05	NA	NA	NA	1.90E-06	1.07E-06	4.00E-04	4.75E-03	2.66E-03
Zinc	1.90E-02	7.79E-05	NA	NA	NA	6.23E-06	3.49E-06	3.00E-01	2.08E-05	1.16E-05
CHEMICAL CLASS-SPECIFIC RISK =										
PATHWAY-SPECIFIC RISK =										
PATHWAY-SPECIFIC RISK (Petroleum) =										
PATHWAY-SPECIFIC RISK (CERCLA-only) =										
						TOTAL CANCER RISK =				
						CUMULATIVE TOXICITY HAZARD =				
TOTAL:										
Petroleum-related:						TOXICITY				
CERCLA-only:						TOXICITY				
						9.70E-06				
						2.14E-06				
						7.56E-06				
						0.00E+00				
						3.72E-06				
						2.22E-07				
						3.50E-06				
						0.11				
						0.1				
						0.0				
						0.0				
						4.18				
						1.22				
						2.96				
						1.54				
						0.38				
						1.16				

* = Petroleum-related chemical

(b) = CDF values not adjusted

(c) = Integrated Risk Information System

(d) = The EPA does not recommend applying a CSF to lead to substantial uncertainty in epidemiological data

(e) = Surrogate toxicity value used based on EPA Region IX PRG Table, October 1999.

(n)= Health Effects Assessment Summary Tables

(g) = Toxicity criteria from EPA Region IX Preliminary Remediation Goals, October 1999

CSF = Cancer Slope Factor

CDI = Chronic daily intake

mg/kg-day = milligrams per kilogram per day

EPC = Exposure Point Concentration

NA = Not Available

NC= not a known carcinogen

NMCRC-LA= Naval and Marine Corps Reserve Center- Los Angeles

RfD = Reference Dose

Table L-11
Summary of Excess Lifetime Cancer Risk and Chronic Hazard Index
NMCRC-LA

Characteristic	Risk from Subsurface Soil ^(a)		Risk from Groundwater ^(a)	
	Total	Non-petroleum-related	Total	Non-petroleum-related
Construction Workers				
Total Cancer Risk	2E-09	9E-11	NA	NA
Total Chronic Hazard Index	9E-03	1E-04	NA	NA
Industrial Workers				
Total Cancer Risk	1E-06	4E-08	NA	NA
Total Chronic Hazard Index	2E-01	3E-03	NA	NA
Residents				
Total Cancer Risk	4E-06	1E-07	5E-5, 1E-5 ^(b)	3E-5, 8E-6 ^(b)
Total Chronic Hazard Index				
Adult	2E-02	2E-02	2E+0, 2E+0 ^(b)	1E+0, 1E+0 ^(b)
Child	2E-01	2E-01	6E+0, 4E+0 ^(b)	3E+0, 3E+0 ^(b)

Notes:

^(a) = Numbers rounded to the nearest integer. Based on reasonable maximum exposure (RME) parameters

^(b) = Using the most conservative cancer potency factor for risk

^(c) = Results based on the use of groundwater model data

Cal-EPA = California Environmental Protection Agency
EPA = Environmental Protection Agency
NMCRC-LA = Naval and Marine Corps Reserve Center-Los Angeles
NA = Not Applicable

Appendix M

Excerpts from Historical Documents

Appendix M
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This appendix contains excerpts from the following previous reports:

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<i>Subsurface Soil Investigation for the Vehicle Lube Rack Area/Underground Storage Tank, Navy Public Works Center, 1996</i>	1
<i>Final CERFA Environmental Baseline Survey (EBS) for Naval and Marine Corps Reserve Center, BNI, 1995</i>	2
Los Angeles Department of Public Works Water Well Reports (from Appendix B of the EBS)	3
<i>Tank Closure Report, Amwest Environmental Engineering, 1995 (from Appendix E of the EBS)</i>	4
<i>Closure Letter, Regional Water Quality Control Board, Los Angeles Region, 1998</i>	5



NAVY PUBLIC WORKS CENTER

ENVIRONMENTAL DEPARTMENT

Underground Storage Tank Removal
and
Site Assessment and Remediation Division


SUBSURFACE SOIL INVESTIGATION REPORT

FOR THE
VEHICLE LUBE RACK AREA/UNDERGROUND STORAGE TANK
NAVAL AND MARINE CORPS RESERVE CENTER
LOS ANGELES, CALIFORNIA
20 SEPTEMBER 1996

Prepared for:

DEPARTMENT OF THE NAVY
Commander Naval Surface Reserve Forces
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ACRONYMS AND ABBREVIATIONS

bgs	below ground surface
BTEX	Benzene, Toluene, Ethylbenzene, and (Total) Xylenes
COC	Chain-of-Custody
COMNAVSURFRESFOR	Commander Naval Surface Reserve Forces West
DOT	Department of Transportation
EBS	Environmental Baseline Survey
IDW	Investigation Derived Waste
mHz	megahertz
msl	mean sea level
NAVFAC	Naval Facilities
NMCRC	Naval and Marine Corps Reserve Center
TEG	Transglobal Environmental Geochemistry
TPH	Total Petroleum Hydrocarbons
TRPH	Total Recoverable Petroleum Hydrocarbons
USEPA	U. S. Environmental Protection Agency
USCS	Unified Soil Classification System
UST	Underground Storage Tank

EXECUTIVE SUMMARY

A Geophysical Survey and a Subsurface Soil Investigation was conducted at the Naval, Marine Corps Reserve Center (NMCRC), Los Angeles, California. The area of investigation included the Vehicle Lube Rack area and the general location of the former Vehicle Service Station underground storage tank (UST) which was indicated on sheet 59 of NAVFAC Drawing 6192358. The UST area and the lube rack area were considered a single investigation site, because of their proximate location to each other. The objectives of this investigation were to (1) determine if the former service station UST still exists, (2) determine if any release had occurred at the site from vehicle maintenance or UST fuel leakage, and (3) determine if additional evaluation is required.

A Geophysical Survey investigation, using ground penetrating radar (GPR), was performed to determine if the UST still exists. A Subsurface Soil Investigation was conducted to assess the presence of contamination from leakage of vehicle maintenance products stored at the lube rack area or fuel leakage from the former UST. The findings of these investigations are to answer questions previously raised in the "Final CERFA Environmental Baseline Survey (EBS) for the Naval Marine Corps Center, Los Angeles, CA" (Bechtel, 1995).

The investigation was conducted in accordance with the "Subsurface Soil Investigation Work Plan for the Vehicle Lube Rack Area/Underground Storage Tank" (Navy Public Works Center, 13 May 1996).

GPR scanning was performed in the area between the Lube Rack and the Vehicle Maintenance Building where site construction drawings indicated the location of the former Vehicle Service Station. The GPR scans indicated a response from the electrical conduit and drain pipe extending from the existing Vehicle Maintenance Building and a disturbance in the clay formation that has the appearance of an excavation boundary area. Based on the GPR indications and gasoline contamination found in this area, it appears that this may be the excavation area where the former service station UST was supposed to have been removed by site construction in 1984-1985. The GPR scans did not show a typical UST response in this area. The Vehicle Maintenance Building and the Lube Rack structures restricted the GPR survey in this area. Several GPR scans were run in the area southeast of the Vehicle Lube Rack where a waste oil UST had been removed on November 9, 1994. The GPR lines were run to look for the waste oil UST excavation and any indications of the service station UST. Only the waste oil UST excavation was indicated.

The site investigation indicated that some gasoline contamination does exist in the area between the Lube Rack and the Vehicle Maintenance Building, as found in soil boring SB-3. The samples taken down to 19 feet in this area all contained gasoline and BTEX. Soil boring SB-2 indicated a significant TRPH level at the 2-foot depth but no detection of diesel or gasoline. This level of TRPH at SB-2 may have resulted from prior storage of petroleum fluids in this area. The minor TRPH detected at borings SB-4 and SB-5 may have been from fine fragments of asphalt in the top several feet of the site which remained from prior construction site grading. TPH analyses for gasoline and diesel were non-detect in borings of other areas except at soil borings SB-2a and SB-3. No groundwater was encountered at the maximum boring depth of 19-feet.

Because of the gasoline contamination found, some limited additional investigation work is considered necessary to determine the extent of the contamination along with an evaluation of any potential groundwater contamination risk that may be present from the release.

1.0 INTRODUCTION

This report presents the findings of the subsurface soil investigation conducted by Navy Public Works Center in conjunction with Transglobal Environmental Geochemistry (TEG) at the site of the Vehicle Lube Rack and former Service Station located at the Naval and Marine Corps Reserve Center (NMCRC), Los Angeles, California.

The purpose of this subsurface soil investigation was to determine if any soil contamination had resulted from a release of petroleum fuel from a former UST that was presumed to have been removed or from fluids that may have drained from the Vehicle Lube Rack area where containers of vehicle maintenance products were stored.

The following tasks were performed for this investigation:

- Conduct a Geophysical Survey
- Collect and analyse soil samples from five soil borings
- Identify soil contamination.

This report includes a description of the site background, subsurface soil investigation activities, evaluation of the analytical results, conclusions and recommendations, and references cited.

2.0 SITE BACKGROUND

2.1 FACILITY LOCATION AND DESCRIPTION

The NMCRC had been operational since 1940 when the main administrative building was built. The site is on nearly 6 acres of land, which is bounded by Elysian Park to the north, residential housing to the south and west and the Los Angeles Stadium to the northeast. The address of NMCRC is 1700 Stadium Way, Los Angeles, California. Figure 2-1 shows the location of the facility in the City of Los Angeles. The assessor's parcel number is 5415-14-900. The NMCRC is located at the bottom of a canyon, which has been graded into three engineered terraces.

Due to the requirements to downsize the military forces, the NMCRC was considered to be an appropriate property to close down and transfer back to the City of Los Angeles. Although the U.S. Navy presently owns the property it has been occupied by the City of Los Angeles under a lease agreement. Commander Naval Surface Reserve Forces West (COMNAVSURFRESFOR), located in San Diego, has managed the property since it was vacated by the military in 1994.

As a part of the requirements to transfer the property, an investigation must be completed on all areas where contamination is suspected and a determination made that the area is not contaminated before the transfer is completed. The 1995 Bechtel EBS report indicated the Vehicle Lube Rack area and the former Service Station UST were the only areas needing further investigation. Since existing site plans indicate that the former UST and the Vehicle Lube Rack area are in the same proximity, both areas have been treated as one site.

2.2 SITE DESCRIPTION

As shown on Figure 2-2 from the 1995 Bechtel EBS report, the Vehicle Lube Rack area located at the NMCRC is on the middle level of three graded terraces on the property. The terrace slopes southeast

toward Bernard Street. The terrace is at an approximate elevation of 400 feet above mean sea level (msl) and the site occupies an area of approximately 0.1 acre.

The Vehicle Lube Rack is a rectangular reinforced concrete slab approximately 14-feet x 45-feet with a small 18" x 18" sump located in its center. The remainder of the site is paved with asphalt for parking. As shown in Figure 2-3, the Vehicle Maintenance Building wall runs parallel to the length of the Lube Rack slab. The northwest edge of the slab area is located approximately 6 feet from the wall of the building. Approximately 10 feet southeast of the slab was the location of the former waste oil UST, removed on November 9, 1994. The Hazardous Substance Storage Shed is located approximately 40-feet southeast of the slab's northeast corner.

2.3 SITE HISTORY

The location of the former Service Station is shown in Figure 2-4 which is Sheet 59 of the NAVFAC Drawing 6192358 Demolition Plot Plan showing buildings including the Service Station that existed at the time of the FY 1984 Reconstruct Reserve Center project. As indicated on this plot plan, the service station building was designated to be demolished and the 1000 gallon underground storage tank was to be removed. However, no documentation was found other than the demolition plan that corroborated the UST removal. In reviewing various plot plans of the reconstruction project, it appears that the suspected area of the former service station UST may have been in the area between the Vehicle Maintenance Building and the Vehicle Lube Rack. The 1995 Bechtel EBS report (Section 5.2.1 and Figure 6-1) indicated that the former Service Station was generally located in the vicinity of the current Vehicle Lube Rack area and Vehicle Maintenance Building.

The Vehicle Lube Rack area was originally used for vehicle maintenance. The site was temporarily used as a Hazardous Waste Storage area between 1987 and 1989 while a new hazardous materials storage facility was being built. The materials stored on the slab were drums containing used oil, solvent, hydraulic fluid, and other new and used vehicle maintenance products. Section 5.1.2 of the Bechtel EBS report stated that information from a Navy Environmental Compliance Evaluation (ECE), which was conducted in May 1988, indicated that the Vehicle Lube Rack area did not have secondary containment and "a significant amount of fluid was leaking" from the drums. It is uncertain if some of the fluids seeped into the soil of the surrounding paved area or if all the leaking fluids may have drained into the Lube Rack sump. Portions of the slab have a slight slope toward the sump. Liquids in the sump drained into the waste oil UST indicated in Section 2.2 of this report.

3.0 ENVIRONMENTAL SETTING

The following sections contain a discussion of the local and surrounding lithology, including the hydrogeology and surface hydrology.

3.1 GEOLOGY/LITHOLOGY

Based on information obtained during the Environmental Baseline Survey (EBS Bechtel, 1995), the NMCRC property is underlain by a thin layer of sand and clay from the Quaternary alluvium. Beneath the Quaternary alluvium is sandstone with minor amounts of shale from the Miocene Epoch Topanga and Puente formations. The Quaternary sediments are a result of erosion from the top of the canyon,

and typically are found filling the bottom between the steep walls of the canyon (EBS Bechtel, 1995). The sand/clay layers were encountered in the waste oil UST removal excavation as set forth in the tank closure report by Amwest Environmental (Appendix E of EBS Bechtel, 1995). This excavation location was approximately 10 feet southeast of the Lube Rack slab, as shown in Figure 2-3.

For this investigation, the geologic findings are consistent with the investigation conducted by Amwest Environmental. The entire site is a uniform layer of a moist, very stiff, silty clay that is grayish brown in color with a few shell fragments and less than 5 % sand.

3.2 HYDROGEOLOGY

Based on information stated in the 1995 Bechtel EBS Report, areas within a 1 mile radius of NMCRC, have groundwater at estimated depths ranging from 17 to 25 feet below ground surface (bgs). The EBS also indicated that the groundwater flow direction appeared to be to the south. Since the areas of this groundwater information are at lower elevations than the NMCRC site, the depth to any groundwater is uncertain, but may be substantial. The information of Amwest Environmental, in Appendix E of the 1995 Bechtel EBS, indicated that groundwater beneath the site as an aquifer is unlikely unless it is a local perched condition. Section 2.2.2 of the EBS stated that there were no known fresh water producing wells in the immediate area of the Los Angeles Coastal Plain including the Elysian Hills.

No groundwater was encountered during soil sampling to a maximum depth of 19 feet, therefore, no groundwater samples were taken and the actual depth bgs to groundwater was not determined by this investigation.

3.3 HYDROLOGY

The level Vehicle Lube Rack area is surrounded by an asphalt paved area that slopes toward the southeast planter wall of the site near Bernard Street. Since the area is paved, rainwater falling on the asphalt paved area drains toward the oil-water separator along the southeast wall shown on Figure 2-2. Rain falling on the Lube Rack slab drains into a Lube Rack sump.

4.0 FIELD INVESTIGATION

The investigation was conducted in accordance with the Navy Public Works Center Site Subsurface Soil Investigation Work Plan, dated 13 May 1996, and supporting plans which included the health and safety plan and the quality assurance plan. Field work, conducted on June 14, 1996, was overseen by a California registered civil engineer.

The objective of the ground penetrating survey (GPR) and the subsurface soil investigation was to determine if the former service station UST was still present and to determine if there was any contamination in the subsurface soil from the UST fuel or materials stored on the Vehicle Lube Rack slab. The following sections present a summary of the field investigation procedures conducted at NMCRC, Los Angeles.

4.1 GEOPHYSICAL SURVEY

A geophysical survey, using ground-penetrating radar (GPR), was performed by hand-towing a 500 megahertz (mHz) transmitter/receiver unit across the area where the former UST was suspected to exist between the Vehicle Maintenance Building and the Vehicle Lube Rack. A series of survey lines crossed over the suspect location to detect any response of the UST or indications of its former location. Similarly, two survey lines (Files 372 & 374) were run in the area of the former waste oil UST to see if there were any indications of a UST. Figure 4-1 indicates the file numbers of the various GPR survey lines that were run across the site. The prints of these GPR files are available in Appendix A.

The GPR scan identified as FILE 469 shows reflections where the electrical conduit and drain pipe extend from the Vehicle Maintenance Building. File 469 does not show a typical parabolic reflection of an existing UST. However, there appears to be a disturbance in the soil formation from about the middle of the building wall to about 5-feet southwest of the retaining wall which suggests a former excavation.

Following the detection of gasoline contamination in this area, additional GPR scans were conducted. The GPR scan of File 633 was run parallel and about 6 feet southeast of the File 469 run, adjacent to Lube Rack slab. File 633 did not show a typical UST reflection. GPR scans were made perpendicular across the Files 469 and 633 traces. The perpendicular scans shown in Files 683,684,689,685,690,691,692,693 & 695 did not show a UST reflection. Each run of these files were only about 8 feet in length between the Vehicle Maintenance Building and the Lube Rack curb. The short length of these GPR runs limited the identification of a soil excavation boundary, since the soil reflections which appeared to be from soil disturbance could not be compared with reflections of adjacent areas of undisturbed soil. Although there appears to be soil disturbance in the area of gasoline contamination, this disturbance does not look the same as the recent excavation of the waste oil UST removed in December 1994 shown in Files 372 and 374. This could be due to several factors such as difference in backfill material, difference in compaction and consolidation over time and moisture in backfill zone. Crushed rock (3/4-inch) was used for backfill in the waste oil UST excavation, whereas on site clay soil may have been used in the gasoline UST excavation backfill. The conductivity of the clay formation adversely influences the GPR data collected and analyzed.

From the GPR survey information of the site areas that were accessible, a typical reflection of a UST for the service station was not detected. However, as discussed above, there appear to be indications of soil disturbance in the area, where gasoline contamination was found, that suggests the excavation of the former tank may have occurred in this area.

4.2 DIRECT PUSH SOIL SAMPLING

Stratoprobe direct push soil sampling technology was used in performing the soil borings. Successive pushes of the Stratoprobe were in 3 to 5 foot vertical increments. Once sample depth was reached the penetration tip of the Stratoprobe was removed and the Stratoprobe sampler pushed into soil an additional 18 inches. Soil samples were obtained in 1-inch diameter by 6-inch long stainless steel sample sleeves of the Stratoprobe split spoon sampler. The middle sampling sleeve, of three sleeves, was immediately removed, checked for odors and its ends capped with Teflon patches and plastic caps. Each sample was immediately taken to the on site mobile laboratory for analysis. The soil samples in

the other two sample sleeves were examined for soil classification / borehole logging. Soil samples were logged with their description prepared by using the Unified Soil Classification System (USCS) and a Munsel Color Chart. In all the borings, the soils encountered were very stiff, silty clay that were grayish brown in color, with a few shell fragments and less than 5% sand. With all the soil samples being the same in each boring, it represented a continuous log of the site's lithology from the surface to the final sample depth. Copies of the soil boring logs are presented in Appendix B. Chain-of-custody (COC) forms, in Appendix C, were completed on site at the time each sample was delivered to the mobile laboratory.

There were three alternate locations proposed in the work plan for the soil sample boring in the center of the Vehicle Lube Rack as shown in Figure 4-2. The first proposed location, labelled SB-1S, was the preferred location since it would be in the center of the sump. The second proposed location, labelled SB-1Sa would be 6 inches southwest of the sump. The third proposed location, SB-1A, would be on the southeastern edge of the Vehicle Lube Rack and would be a slant boring. It was determined that a concrete coring could provide for a borehole to be drilled next to the sump, instead of in the sump, and thereby prevent any contaminants in the sump getting into the soil. Therefore, location SB-1Sa was chosen instead of SB-1S or SB-1A. All other borings were performed at the locations set forth in the project work plan. Figure 4-2 indicates the measured location of each boring in relation to the front corner and the back corner of the Vehicle Maintenance Building. Photographs in Appendix F show the boring operations of the investigation.

Because of gasoline contamination found at boring location SB-3, some additional sampling was performed by extending the boring depth to 19 feet below ground surface (bgs) and taking additional samples at 13 feet and 19 feet bgs. Prior to taking samples at boring location SB-1Sa, a concrete coring was cut through the 1 foot thick concrete slab. The concrete surface at SB-1Sa, next to the sump, was approximately 1.5 feet below the other slab surface area of the Lube Rack. To take a soil sample below the slab base foundation fill, the first sample was taken several feet below the bottom of the concrete slab. Taking into consideration the depth of the sump area, the slab thickness and the thickness of the foundation fill, the first soil sample depth at SB-1Sa was indicated at 6 feet bgs of the site.

Since immediate laboratory analysis was performed on the soil samples, field screening of the soil using an Organic Vapor Analyzer (OVA) was considered unnecessary. Odor checks were made of the soil samples and noted on the boring logs.

All sampling equipment was decontaminated prior to the first boring and after use in each boring according to the following decontamination procedure:

- Wash in potable water and Alconox
- Potable water rinse
- Deionized or purified water rinse/spray

All decontamination washwater was containerized in a Department of Transportation (DOT)-approved 5-gallon bucket for proper disposal. Soil samples were the only soil cuttings transported offsite. The total volume of soil samples amounted to a quantity contained in 2-gallon container. Disposal of sample soil and decontamination washwater is discussed in Section 4.3.

4.3 INVESTIGATION-DERIVED WASTE

Decontamination washwater, rinsewater and soil were generated from this investigation. TEG, the onsite drilling and mobile laboratory contractor, transported the soil samples and approximately 5-gallons of decontamination water to their facility located in Solana Beach, California. At the TEG facility, the water and soil was deposited in DOT approved 55-gallon drums. TEG disposes of each drum of water and soil at EPA approved facilities within the 90 day storage time limit, as stated in their September 4, 1996 letter in Appendix D.

5.0 SITE EVALUATION

5.1 ANALYTICAL RESULTS AND EVALUATION

The laboratory analyses of the soil obtained were performed by a mobile laboratory run by TEG. The following potential site contaminants were addressed by the corresponding analysis method:

◦	TPH	USEPA Method 8015 Modified
◦	TRPH	USEPA Method 418.1
◦	BTEX	USEPA Method 8020 Modified
◦	Volatile Halogenated Hydrocarbons	USEPA Method 8010
◦	Organic Lead	CA DHS Method

Analytical results are summarized in Table 5.1 and are also listed in Appendix E. Table 5.1 includes only those samples where at least one analyte was detected. The contaminants, shown in Table 5-1, confirm gasoline contamination between the Lube Rack and Vehicle Maintenance Building for soil boring SB-3 (sample number SB-3-002, 005, 010, 013, 019). Soil boring SB-S1a indicates a minor amount of gasoline contamination at the 11-foot depth. The elevated TRPH readings of the 2-foot sample of boring SB-2 may be from the leakage of vehicle maintenance petroleum fluids that were noted in the Navy's Environmental Compliance Evaluation of 1988 as stated in Section 2.3 above. This is considered only a surface contamination, since the sample at 5-feet bgs indicated non-detect. Minor levels of TRPH detected at other boring locations may have been from fragments of asphalt remaining in the soil from the area reconstruction project. There was no visible staining on the concrete of the lube rack slab which indicated spills or extensive leakage of petroleum products in the area. TRPH in borings SB-3 and SB-1Sa corresponded to gasoline detected in the soil samples.

5.2 SITE CONCEPTUAL MODEL

Due to the limited soil investigation, the extent of contamination reaching exposure pathways is inconclusive; however, the following general considerations can be made.

Based on present site conditions, there appears to be little potential for exposure to the gasoline-impacted soils from the surface. All of the area of the former service station is paved or under the Vehicle Maintenance Building or Vehicle Lube Rack. This surface condition prevents exposure from fumes or dust emissions and minimizes any surface water migration through the soil.

Surface water is unlikely to cause any contaminant migration through the soil since the site paving carries the rainwater runoff flows away from the site toward the southeast planter wall. There is a slope embankment retaining wall behind the Vehicle Maintenance Building located about 10 feet northeast of the building, which also affects the flow of the surface water runoff. In addition, the soil is a silty clay which restricts vertical migration of water.

As stated in the Bechtel 1995 EBS report, groundwater investigations located within a 1-mile radius of the site indicated groundwater depths of 17 to 25 feet bgs. Further review of the EBS data including hydrogeology information by Amwest Environmental in the EBS Appendix E indicated that groundwater beneath the site as an aquifer is unlikely unless it is a local perched condition. Section 2.2.2 of the EBS stated that there were no known fresh water producing wells in the immediate area of the Los Angeles Coastal Plain including the Elysian Hills. Based on the information, it is uncertain that any usable groundwater has been impacted by the gasoline contamination indicated at 19 feet in boring SB-3.

5.3 CONCLUSIONS

The following conclusions are based on the results of this subsurface soil investigation and GPR survey:

- There is limited indication that petroleum contaminants other than diesel or gasoline occurred within the upper 2-feet bgs of the Vehicle Lube Rack area. The higher level TRPH at boring SB-2 may have resulted from the leakage of stored petroleum fluids that was noted in Section 2.3 of this report. However, some of the TRPH may have been from minor fragments of asphalt that remained in the soil from prior site reconstruction grading. At boring locations SB-2, SB-4, and SB-5, TRPH was not detected in samples below the 2 foot depths. TRPH was detected at borings SB-1Sa and SB-3 where gasoline was detected.
- The GPR survey did not indicate a typical reflection of an underground storage tank in the suspect area of the former Service Station UST. There were GPR indications that an excavation of the service station UST may have occurred in the area between the Vehicle Maintenance Building and the Vehicle Lube Rack.
- The gasoline detected in the soil boring SB-3 confirms a release that appears to have been from the UST location of the former Service Station. Site drawings indicate that the location of the former gasoline UST was probably in the area between the Vehicle Maintenance Building and the Lube Rack, although the tank may have been partially in the area under the Vehicle Maintenance Building or the Lube Rack.
- It is uncertain that the groundwater has been impacted. The gasoline contamination levels are low such that free product was not encountered to 19 feet. Statements from the EBS report indicate that an aquifer under the site is unlikely and that no fresh water wells are known in the area.

5.4 RECOMMENDATIONS

Further investigation is recommended to determine the extent of contamination and if a potential impact to groundwater exists. This would include the following actions:

- Perform several soil borings to determine the extent of contamination.
- Based on the extent of contamination, install a monitoring well to determine the depth to groundwater and if it has been impacted

6.0 REFERENCES

California State Water Resources Control Board (SWRCB). "Leaking Underground Fuel Tank Manual: Guidelines for Site Assessment, Cleanup, and Underground Storage Tank Closure;" State of California, Leaking Underground Fuel Tank Task Force, Sacramento, California, 1989.

USEPA. "Data Quality Objectives process for Superfund Workbook." Office of Emergency and Remedial Response. EPA 540-R-93-078, Washington, D.C., September 1993.

California Department of Conservation, Division of Mines and Geology. Special Report #101, Geology of Elysian Park Repetto Hills Area, Los Angeles, California, 1970.

Bechtel National, Inc. "Final CERFA Environmental Baseline Survey for Naval and Marine Corps Reserve Center, Los Angeles, California;" August 1995.

Navy Public Works Center. "Work Plan For Final Subsurface Soil Investigation of the Vehicle Luberack Area/Underground Storage Tank, Naval and Marine Corps Reserve Center, Los Angeles, California," May 13, 1996.

Table 5.1
Detected Analytes
(mg/kg)

Boring Number	Boring Depth	IRPH	IPH Gasoline	IPH Diesel	Benzene	Toluene	Ethyl Benzene	Xylenes	1,2- Dichloro Ethane
SB-4	2'	778	ND	ND	ND	ND	ND	ND	ND
SB-5	2'	50	ND	ND	ND	ND	ND	ND	ND
SB-1SA	9'	ND	ND	ND	ND	ND	ND	ND	0.0181
SB-1SA	11'	32	24	ND	0.075	0.028	0.172	0.535	ND
SB-2	2'	2,845	ND	ND	ND	ND	ND	ND	ND
SB-3	2'	1,088	368	ND	0.503	0.364	1.643	2.634	0.0062
SB-3	5'	258	327	ND	1.9	0.7	4.9	20.6	ND
SB-3	10'	883	1,447	ND	4.2	35.3	17	106	ND
SB-3	13'	1,100	1,164	ND	4.0	59	28	162	ND
SB-3	19'	2,642	3,760	ND	7.0	111	73	371	ND

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Contract No. N68711-92-D-4670

**COMPREHENSIVE LONG-TERM ENVIRONMENTAL
ACTION NAVY
CLEAN II**

**FINAL CERFA
ENVIRONMENTAL BASELINE SURVEY
FOR
NAVAL AND MARINE CORPS
RESERVE CENTER
LOS ANGELES, CALIFORNIA**


CTO-0066

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August 1995

Signature: 
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Date: 7 Aug 1995

SUMMARY

This Environmental Baseline Survey (EBS) report for the Naval and Marine Corps Reserve Center (N&MCRC), Los Angeles, California, has been prepared for the Department of Navy, Naval Readiness 20, by Bechtel National Inc (BNI), on behalf of Department of the Navy, Southwest Division Naval Facilities Engineering Command (SWDIV). The work was performed in accordance with Contract Task Order (CTO)-0066, issued under the Comprehensive Long-Term Environmental Action Navy (CLEAN) II Contract No. N68711-92-D-4670. The plot plan for the N&MCRC is Figure ES-1.

The purpose of the EBS is to evaluate Federal real property and describe its environmental condition specifically with respect to the presence of hazardous substances and petroleum products. The EBS report will be used by the U.S. Navy for compliance with the requirements of the Community Environmental Response Facilitation Act (CERFA), which calls for early identification of property suitable for transfer.

This EBS evaluated the environmental conditions both of the real property owned or leased by the U.S. Navy at the N&MCRC and of adjacent non-Navy owned property. It should be noted that this report makes no determinations regarding the transfer potential of property; it only describes the environmental condition of the property based on reasonably available information and the investigation as described herein.

Real estate transfer and lease determinations are solely the responsibility of the U.S. Navy. Concurrence will be sought from the State of California as to any U.S. Navy findings of suitability for transfer of property based on the U.S. Navy's interpretation of the information on environmental conditions presented in this EBS as well as additional considerations as applicable.

This EBS report categorized facility findings into seven area types as defined by the U.S. Navy. The following describes the EBS facility findings for the N&MCRC.

EBS Facility Findings Area Type 1 - *Areas where no storage, release, or disposal of hazardous substances or petroleum products has occurred, including no migration of these substances from adjacent areas.* All site locations except those listed in the Facility Findings Area Types 2 through 7 are identified as EBS Facility Findings Area Type 1.

EBS Facility Findings Area Type 2 - *Areas where only storage of hazardous substances or petroleum products has occurred, but, no release, disposal, or migration from adjacent areas has occurred.* The following site locations have been identified as EBS Facility Findings Area Type 2:

- Hazardous Substance Storage Area, and
- Open Field Area - Paint Shed.

EBS Facility Findings Area Type 3 - *Areas where storage, release, disposal, and/or migration of hazardous substances or petroleum products has occurred, but at concentrations that do not require a removal or remedial action.*

- No site locations identified

Summary

EBS Facility Findings Area Type 4 - *Areas where storage, release, disposal, and/or migration of hazardous substances or petroleum products has occurred, and all remedial actions necessary to protect human health and the environment have been taken.* The following site location has been identified as EBS Facility Findings Area Type 4:

- Former Waste-Oil UST Location

EBS Facility Findings Area Type 5 - *Areas where storage, release, disposal, and/or migration of hazardous substances or petroleum products has occurred, removal and/or remedial actions are underway, but all required remedial actions have not yet been taken.*

- No site locations identified

EBS Facility Findings Area Type 6 - *Areas where storage, release, disposal, and/or migration of hazardous substances or petroleum products has occurred, but required response actions have not yet been implemented.*

- No site locations identified

EBS Facility Findings Area Type 7 - *Areas that are unevaluated or require additional evaluation.*
The following site locations were identified as EBS Facility Findings Area Type 7:

- Vehicle Lubrack Area,
- Former Location of the Service Station, and
- Administration Building Basement - Small Arms Firing Range

To account for migration of chemicals from known, likely, or potential sources, a buffer zone of uncertainty was added around each area of concern. Zones of uncertainty may be further delineated in future investigations.

Section 1

PURPOSE OF THE ENVIRONMENTAL BASELINE SURVEY

This Environmental Baseline Survey (EBS) report for the Navy and Marine Corps Reserve Center (N&MCRC), Los Angeles, California, has been prepared for the Department of Navy, Naval Readiness 20, by Bechtel National, Inc. (BNI), on behalf of the Southwest Division Naval Facilities Engineering Command (SWDIV), in accordance with Contract Task Order (CTO)-0066, issued under the Comprehensive Long-Term Environmental Action Navy (CLEAN) II contract No. N68711-92-4670.

The purpose of this EBS report is to describe the environmental conditions of N&MCRC as of July 1995 using existing reasonably available information. This report is being used by the U.S. Navy to meet the requirements of the Federal Community Environmental Response Facilitation Act (CERFA), ratified as Public Law 102-426 on 19 October 1992. CERFA amends section 120(h) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, and was enacted to expedite the identification of real property suitable for transfer. Identification of suitability for transfer is based upon investigations of real property to determine or to discover the obvious presence or likely presence of certain hazardous substances and petroleum releases. CERFA further requires that the investigation focus on record review, visual and physical site inspections, and interviews. Accordingly, the evaluations and conclusions, herein, are based on available information as of the date of this report. Should information become available that remedial action be necessary, the federal government will take any action required by CERCLA Section 120(h) (3) (c).

This report evaluates the present conditions at the N&MCRC based on government furnished data, previous studies, and reports and other documents as identified herein. The gathered information has been reasonably relied on and has not been reverified by the CLEAN II contractor. The information has been supplemented by personal interviews and visual inspections performed by the CLEAN II contractor. Neither soil nor groundwater sampling was performed during this investigation. The evaluation and conclusions in this report are based on currently available information and could vary if further data concerning the N&MCRC, its conditions or other information are made available.

The following briefly describes the sections that comprise this EBS report. Section 2 describes the boundaries and the physical and natural conditions of the survey area. Section 3 describes the survey method. Section 4 gives a brief history of the N&MCRC and describes the current land use of adjacent properties. Section 5 presents the findings on the environmental condition of the property based on an examination of existing reasonably available information. Section 6 summarizes the findings of the installation by grouping into one of the seven area types shown in Table 1-1.

This EBS has been prepared in accordance with Department of Defense (DoD) guidance entitled DoD Policy on the Implementation of the Community Environmental Response Facilitation Act (CERFA), dated 9 September 1993.

Section 1 Purpose of the Environmental Baseline Survey

Table 1-1
EBS Facility Findings Area Types

Number	Description
1	Areas where no storage, release, or disposal of hazardous substances or petroleum products has occurred, including no migration of these substances from adjacent areas.
2	Areas where only storage of hazardous substances or petroleum products has occurred; but, no release, disposal, or migration from adjacent areas has occurred.
3	Areas where storage, release, disposal, and/or migration of hazardous substances or petroleum products has occurred, but at concentrations that do not require a removal or remedial action.
4	Areas where storage, release, disposal, and/or migration of hazardous substances or petroleum products has occurred, and all remedial actions necessary to protect human health and the environment have been taken.
5	Areas where storage, release, disposal, and/or migration of hazardous substances or petroleum products has occurred, removal and/or remedial actions are underway, but all required remedial actions have not yet been taken.
6	Areas where storage, release, disposal, and/or migration of hazardous substances or petroleum products has occurred, but required response actions have not yet been implemented.
7	Areas that are unevaluated or require additional evaluation.

Section 2

PROPERTY IDENTIFICATION

This section presents the physical description and the environmental setting of the N&MCRC. The landscape and natural surroundings are included in the physical description. The environmental setting describes the geologic, hydrogeologic, and hydrologic characteristics of the site.

2.1 PHYSICAL DESCRIPTION

The physical description of the N&MCRC includes the following site location and topographical setting.

2.1.1 Location

The N&MCRC is located at 1700 Stadium Way in the City of Los Angeles, Los Angeles County, California. Figure 2-1 is a regional map and Figure 2-2 is a site vicinity map showing the N&MCRC site. The N&MCRC is located on nearly 6 acres of land approximately 0.5 miles northeast of downtown Los Angeles. The site is bounded by Elysian Park (which is operated by the Los Angeles County Parks and Recreation Commission) to the north, by residential housing to the south and west, and by a baseball stadium (Los Angeles Dodgers) to the northeast.

A legal description of the N&MCRC property from the Los Angeles County Assessors office is included as Appendix A to this document.

2.1.2 Topography

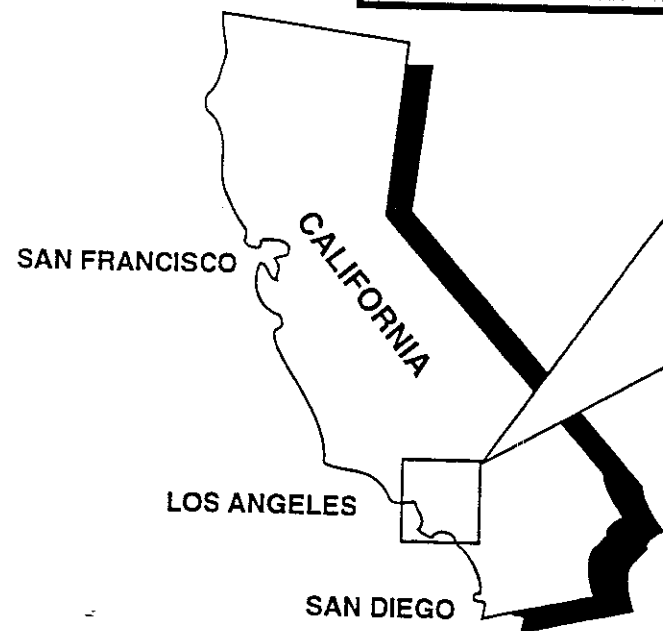
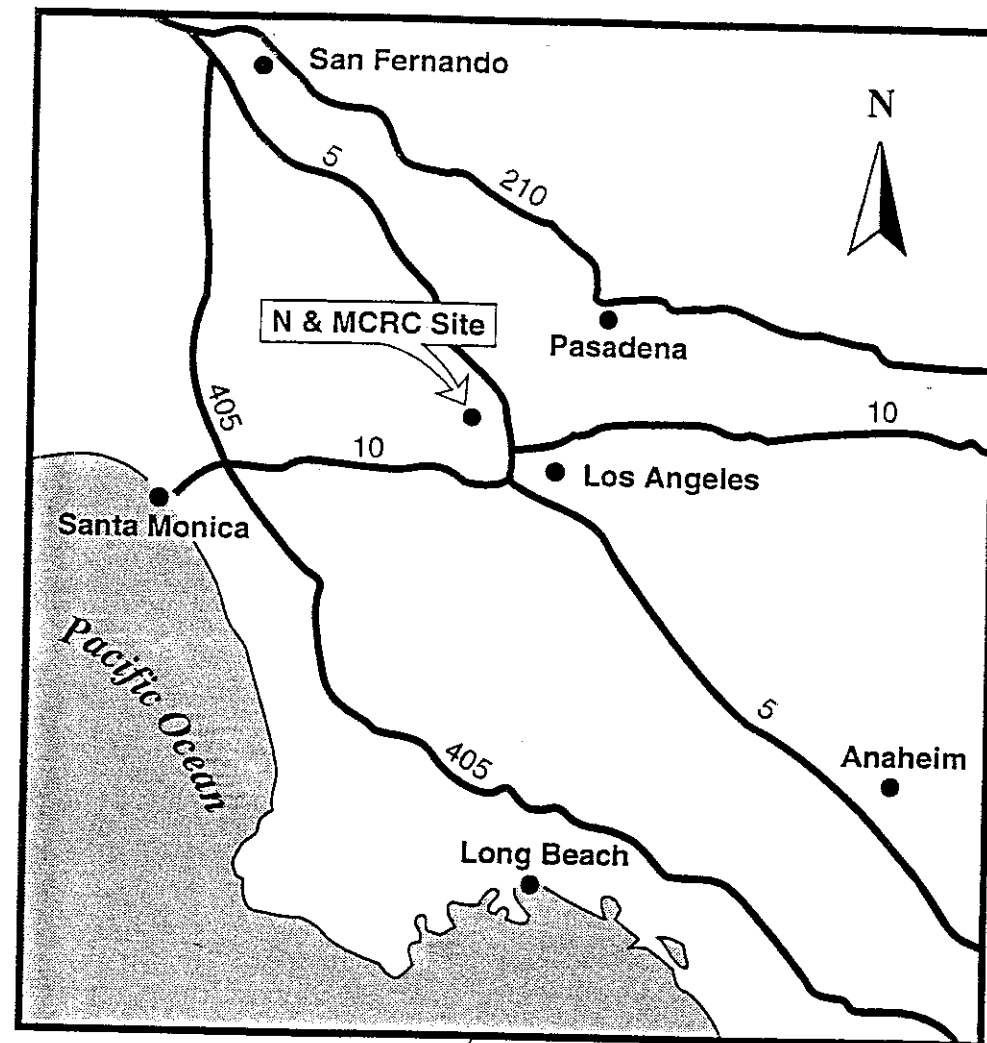
The N&MCRC site is located in Chavez Ravine in the hilly terrain of the Elysian Hills. Elevation in the nearby vicinity ranges from 400 feet above mean sea level (MSL) on-site, to 700 feet above MSL in the surrounding hills. Surface elevations at the N&MCRC vary within 50 feet across the site property. These abrupt elevation differences are due to engineered terraces from building and parking lot construction.


2.2 ENVIRONMENTAL SETTING

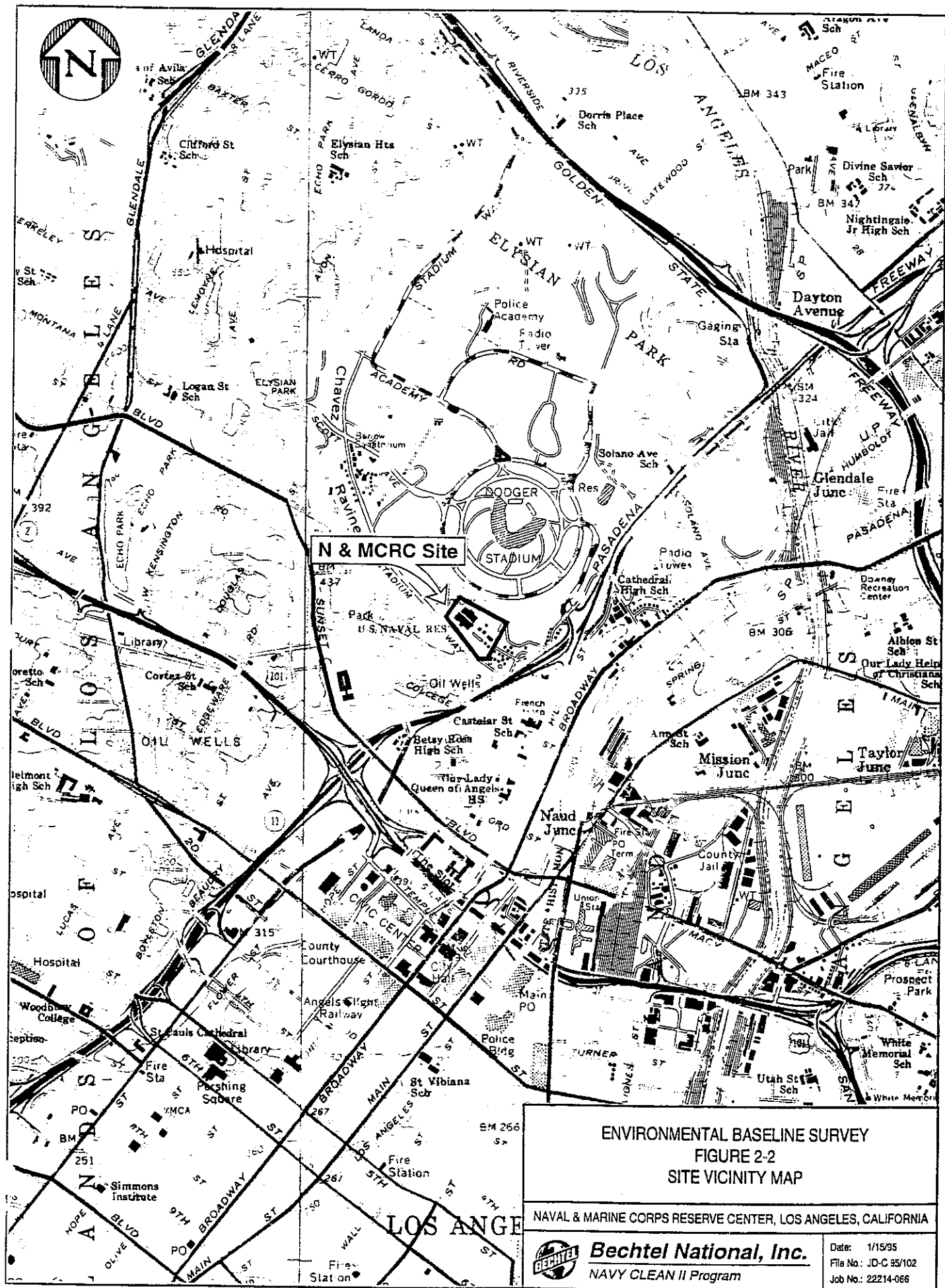
The following sections contain a discussion of the local and surrounding geology, including structural geology, stratigraphy, hydrogeology, and surface hydrology.

2.2.1 Geology

The N&MCRC is located in the Elysian Hills, which are bounded by the Santa Monica Mountains to the north and west, the Los Angeles Narrows and Repetto Hills to the east, and the eastern margin of the central block of the Los Angeles Basin to the south. The general geology of the area is complex due to folding and faulting of the subsurface rock units throughout geologic time. The Elysian Hills are composed of folded sedimentary rocks of Miocene age with Holocene alluvial sediments filling in the valley bottoms.



ENVIRONMENTAL BASELINE SURVEY FIGURE 2-1 REGIONAL MAP	
NAVAL & MARINE CORPS RESERVE CENTER, LOS ANGELES, CALIFORNIA	
 Bechtel National, Inc. NAVY CLEAN II Program	Date: 1/15/95 File No.: JD-C 95/101 Job No.: 22214-068



Section 2 Property Investigation

[California Department of Conservation (CDC), Division of Mines and Geology (DMG) 1970]

2.2.1.1 STRUCTURAL GEOLOGY

The Elysian Park-Repetto Hills area is located at the intersection of the east- to northeast-trending Santa Monica fault system and the possible extension of the northwest trending Whittier fault system (CDC, DMG 1970). The principal geologic structures in the Elysian Hills include the east-west trending Elysian Park anticline and secondary folding and faulting that deforms its southern flank [California Department of Water Resources (CDWR), Southern Division 1988]. Folding, faulting, and erosion of the rock units have exposed the rocks at the surface.

The Raymond fault is located at the southern margin of the Verdugo Hills, and is the nearest active fault, located approximately 5 miles northeast of the N&MCRC (CDC, DMG 1985). Figure 2-3 is a regional geologic map showing the N&MCRC site.

2.2.1.2 STRATIGRAPHY

The principal sedimentary rock units in the Elysian Hills area are the Topanga and Puente formations of middle and late Miocene age. These rock formations have a maximum combined thickness within the Los Angeles Basin of approximately 20,000 feet.

The Topanga formation consists predominantly of massive conglomeritic sandstone and minor amounts of shale. The Puente formation is similar to the Topanga formation but contains less conglomerate content (CDC, DMG 1970). Both of these rock units are steeply tilted and dip to the south.

Unconformably lying over the Miocene age Topanga and Puente formations is a thin section of recent Quaternary alluvium, consisting of sand and clay (CDWR 1988). The sediments are a result of erosion from the surrounding hills, and typically are found filling the valleys between the steep hills. These sediments are found in Chavez Ravine where the N&MCRC site is located. Figure 2-4 shows a typical cross section through the Elysian Park-Silver Lake area, indicating the presence of the Topanga and Modelo formations. The Modelo formation is geologically equivalent to the Puente formation [Los Angeles County Department of Public Works (LADPW) 1988].

2.2.2 Hydrogeology

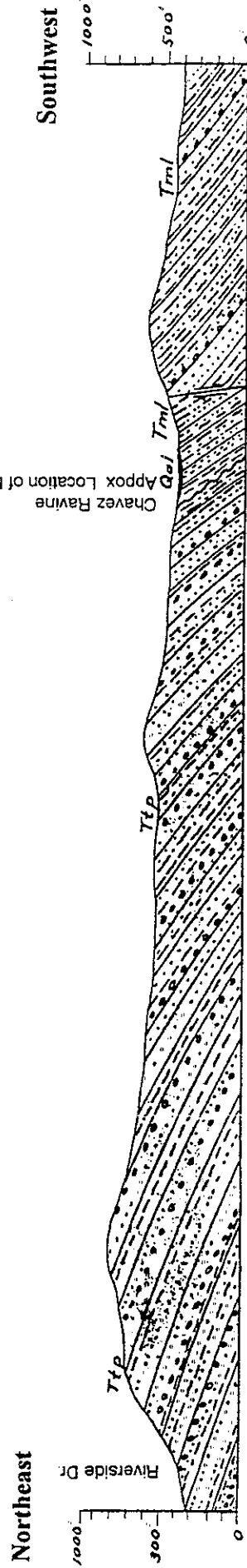
The N&MCRC site is located adjacent to the mouth of the Los Angeles Narrows where the Los Angeles River enters the Los Angeles Forebay area of the Central Groundwater Basin (LADPW 1988). Files reviewed at the California Regional Water Quality Control Board (RWQCB), Los Angeles Region, showed numerous groundwater investigations located within a 1-mile radius of the N&MCRC site. The investigation recorded depth to groundwater ranged from 17 to 25 feet below ground surface (bgs). Regional groundwater flow direction at each of the sites reviewed is to the south.

GEOLOGIC SECTIONS
THROUGH THE ELYSIAN PARK-SILVER LAKE DISTRICT

Horizontal and vertical scale
1" = 1000'




By Harry W. Carlson
1945



- LEGEND
- Sandstone
 - Siltstone
 - Conglomeritic Sandstone
 - Fault

- EXPLANATION
- Qal - Quaternary alluvium
 - Tml - Tertiary Modelo formation
 - Ttp - Tertiary Topanga formation
 - Jgr - Jurassic granodiorite

ENVIRONMENTAL BASELINE SURVEY FIGURE 2-4 TYPICAL GEOLOGIC CROSS SECTION THROUGH ELYSIAN PARK-SILVER LAKE DISTRICT	
NAVAL & MARINE CORPS RESERVE CENTER, LOS ANGELES, CALIFORNIA	
 Bechtel National, Inc. NAVY CLEAN II Program	Date: 1/15/95 File No.: JD-C 95/105 Job No.: 2214-066

Reference: Geology of Elysian Park-Silver Lake District
Los Angeles County, California
By Harry Carlson, 1945

Section 2 Property Investigation

Since the regional groundwater flow direction is to the south, the sites overseen by the RWQCB, Los Angeles Region do not appear to have the potential to impact groundwater quality beneath the N&MCRC site.

No wells are known to produce fresh water from the Topanga or Puente formations in the immediate area of the Los Angeles Coastal Plain, including the Elysian Hills (LADPW 1988).

There are no known potable or industrial use groundwater wells located within a 1-mile radius of the N&MCRC site (CDWR n.d.). There are several groundwater observation wells registered to the CDWR and LADPW. These wells are located approximately 2 miles north and east of the site in the San Fernando Groundwater Basin (Appendix B). Depth to groundwater in the wells ranges from 20 to 75 feet bgs. Groundwater in the San Fernando Groundwater Basin flows southeast through the San Fernando Valley and continues south through the Los Angeles Narrows which is east of the facility (LADPW 1988) into the Los Angeles Coastal Plain Central Basin (LADPW 1988).

2.2.3 Hydrology

Approximately 80 percent of the N&MCRC is paved surface. The paved surface comprises the lower parking lot area that is west of the Administration Building and the upper service area that is south of the Administration Building. The lower parking lot area drains into the northwest-southeast trending Stadium Way. The upper service area drains to the southeast toward surface streets in a residential area.

Section 5 FINDINGS

Section 5 presents on-site hazardous materials and waste management practices identified after visual inspections, personal interviews, and files and investigation reports were reviewed regarding N&MCRC activities. Conclusions of the findings are discussed in Section 6 of this report.

5.1 HAZARDOUS SUBSTANCE MANAGEMENT

The following subsections are based on available information provided by the Navy regarding past hazardous materials and hazardous waste products stored at the N&MCRC.

5.1.1 Hazardous Materials/Petroleum Products Management

Hazardous materials and petroleum products were used during normal activities at the N&MCRC. Small quantities of hazardous materials were normally used or stored in the following locations on the N&MCRC site:

Hazardous Substance Storage Area

The Hazardous Substance Storage Area is located between the Vehicle Maintenance Building and the Vehicle Washrack (Figure 3-1). Hazardous substances were stored in a three-sided canopy shed, with a concrete floor bermed on all sides. The materials stored in this area were stored in 5-, 25-, and 55-gallon steel cans and drums on wooden pallets. All other solid materials were stored on wooden pallets. Table 5-1 lists typical hazardous materials and types of containers stored in the Hazardous Substances Storage Area.

Administration Building Gymnasium - Large Artillery Guns

Two large artillery guns are located in the Administration Building gymnasium. The guns contain a hydraulic oil reservoir with a three gallon capacity. The hydraulic oil was circulated within a closed system and contained above ground. There was no evidence of hydraulic oil stains on the gymnasium floor.

Open Field Area

A Paint Shed located in the Open Field area was used to store paint and non-flammable materials. The building is approximately 25 feet long and 7 feet wide. The floor of the building is cement and the structure sits on an asphaltic concrete pad. The pad and building floor show no signs of weathering, spillage or staining. The concrete floor of the shed is in good condition, but has one hairline crack in the middle of the floor.

5.1.2 Hazardous Waste and Petroleum Waste Products Management

Small quantities of hazardous waste were generated from hazardous substances at the N&MCRC site. The wastes were segregated and stored in the Hazardous Substance Storage Area. Table 5-2 lists each hazardous waste typically stored at any given time on the N&MCRC site and its hazard classification. This information was compiled from

Section 5 Findings

reviewing copies of hazardous waste manifests on-site and by visual inspection of the facility

During the ECE performed in May 1988 (U.S. Department of Navy 1988a) the following hazardous waste management findings were reported:

May 1988

- The Luberack Area was being used for storing drums of hazardous materials and "a significant amount of fluid was leaking" from the drums. The area was not bermed.

Section 5 Findings

Table 5-1
Hazardous Materials Stored on the N&MCRC Site

Hazardous Material	Type of Container
Antifreeze	55-gallon steel drums
Dry Sweep	55-gallon steel drums
Cleaning Solvent	55-gallon steel drums
Artillery Grease	25-pound steel cans
Diesel Fuel	55-gallon steel drums
Gasoline	5-gallon steel can
Brake Fluid Silicone	5-gallon steel can
Hydraulic Fluids	5-gallon steel can
Paint	5-gallon steel can
Paint Stripper	5-gallon steel can
Paint Thinner	5-gallon steel can
Batteries with Barium, Lithium, Magnesium, Carbon Zinc, and Mercury	Cardboard Boxes

Table 5-2
Hazardous Waste Stored on the N&MCRC Site

Hazardous Waste Description	Hazardous Waste Classification
Petroleum Waste Oil	Non-RCRA ¹ Hazardous Waste Liquid, California Regulated Waste
Petroleum Waste Grease	Non-RCRA Hazardous Waste Liquid, California Regulated Waste
Waste Antifreeze	Non-RCRA Hazardous Waste Liquid, California Regulated Waste
Absorbent with Petroleum Products	Non-RCRA Hazardous Waste Solid, California Regulated Waste
Waste Batteries with Barium, Lithium, Magnesium, Carbon Zinc, and Mercury	Waste Environmentally Hazardous Substance Solid N.O.S. ² , California Regulated Waste
Filters with Petroleum Products	Non-RCRA Hazardous Waste Solid, California Regulated Waste
Waste Latex Paint with Ethylene Glycol	Non-RCRA Hazardous Waste Liquid, California Regulated Waste
Waste Floor Wax	Non-RCRA Hazardous Waste Liquid, California Regulated Waste
Waste Corrosion Preventative Aerosol with Barium	Waste Aerosols, Non-RCRA Hazardous Waste, California Regulated Waste
Waste Corrosive Liquids	Waste Corrosive Liquids, Non-RCRA Hazardous Waste Liquid, California Regulated Waste

Notes:

¹ RCRA – Resource Conservation and Recovery Act

² N O S – Not Otherwise Specified

Section 5 Findings

5.2 UNDERGROUND/ABOVEGROUND STORAGE TANKS

A review of N&MCRC files and visual inspections shows that two underground storage tanks (USTs) have historically been used to store petroleum products and petroleum waste products. Table 5-3 lists the known USTs, their capacities, and status.

Table 5-3
Historical List of USTs at the N&MCRC Site

Description	Capacity	Status
Gasoline Storage (Site of Former Service Station)	unknown	unknown
Waste-Oil Storage	2,000 gallons	removed

Presently, there are no aboveground storage tanks on the N&MCRC site. From the files reviewed during this investigation, there is no historical documentation of aboveground storage tanks located on N&MCRC property.

5.2.1 Gasoline Storage

There are records that show evidence of a former gasoline service station located on the N&MCRC facility. N&MCRC property records show the service station was installed in 1943 and was used as a fueling station for vehicles on-site (N&MCRC, 1987). An as-built drawing, circa 1967, was found in N&MCRC files showing a structure on-site identified as a service station (N&MCRC, 1987). The aboveground portions of the service station have been removed. The service station was located in the vicinity of the present-day Vehicle Maintenance Building and Vehicle Lubrack area (see Figure 3-1). Figure 5-1 is a recreated site plot plan showing the location of the service station, circa 1967.

The May 1988 ECE notes that prior to 1980, the fueling facility pumps, UST, and associated underground piping were removed. However, there is no documentation nor drawings that describe the exact location or removal of the UST and its associated piping. The ECE also documented an environmental concern regarding potential soil contamination from the service station (Department of Navy Environmental Compliance Evaluation, 1988).

5.2.2 Waste-Oil Storage

A Waste-Oil UST was located immediately south of the present-day Vehicle Maintenance Building and Vehicle Lubrack. The UST was a 2,000-gallon, double-walled plasteel tank. The UST was removed on 9 November 1994. The former Waste-Oil UST is discussed further in Section 5.3. The UST closure report is presented in Appendix E.

Section 5 Findings

5.2.3 Pipelines

The existing pipelines located on N&MCRC property consist of underground utility pipelines for natural gas and water as well as sanitary sewer connection lines. The oily water separator is connected to the sanitary sewer located at the south property line on Bernard Street.

5.3 PETROLEUM HYDROCARBON AND CHEMICAL CONTAMINATION

None of the files reviewed during this investigation indicate that petroleum hydrocarbon or chemical contamination in soil had been reported at levels which required remedial action on the N&MCRC site. No groundwater investigations have been conducted at the N&MCRC site.

Two limited subsurface investigations were performed at the facility. In 1983, a geotechnical investigation was performed as part of the Vehicle Maintenance Building construction. No chemical analysis was performed during the investigation.

On 9 November 1994, the Waste-Oil UST was excavated and removed. Samples were collected beneath the excavated UST and from the surrounding UST backfill. These samples were below City of Los Angeles Fire Prevention Bureau action levels for further remedial action. The soil analytical results were non-detect for total recoverable petroleum hydrocarbons, toluene, ethylbenzene and xylene. Low levels of benzene were detected in samples collected beneath the excavation (see Appendix E).

The samples collected from the backfill were contaminated with petroleum hydrocarbons. The backfill was removed from the excavation and taken off-site for disposal. A visual inspection by Clean II personnel on 22 December 1994, confirmed the UST excavation was filled with imported soil and paved to its original grade.

5.4 LEAD

The files available for review during this investigation did not indicate any known lead contamination reported at the N&MCRC site. There is a Small Arms Firing Range located in the basement of the N&MCRC Administration Building. Lead fragments from spent bullets were contained in a sandpit located at the base of the firing range backstop. Section 5.10.4 describes the firing range in detail.

Lead-based paints were stored in the Hazardous Substance Storage Area on the N&MCRC facility. Lead-based paints are suspected to have been used on the inside walls of the Administration Building.

Section 5 Findings

5.5 ASBESTOS

A survey for asbestos-containing materials (ACM) was completed at the N&MCRC in November 1992. The survey concluded that ACM was present in vinyl floor tiles and wall plaster at several locations in the Administration Building (Dames and Moore 1993).

The asbestos survey reported that ACM in the vinyl floor tiles was non-friable, but may become friable if damaged. The report stated that vinyl floor tiles located in the east end of the 2nd floor tower of the Administration Building and the basement laboratory were in poor condition and recommended abatement. The report also recommended additional sampling of the wall plaster to better locate the ACM (Dames and Moore 1993).

Table 5-4
Summary of Results from N&MCRC Asbestos Survey

Location	Description of ACM	Est. Quantity	Type of ACM	% ACM	Friability	Condition
Admin. Building	Wall Plaster	100,000 SF	Chrysotile	0 - 5	Non-friable	Good
Admin. Building 2nd Floor, East End of Tower	9"x 9" Green Vinyl Floor Tile	200 SF	Chrysotile	10 - 20	Non-friable	Poor
Admin. Building Top of East End Tower	10" x 10" Tan	300 SF	Chrysotile	2	Non-friable	Poor
Admin. Building Basement Laboratory	9" x 9' Gray Vinyl Floor Tile	3,000 SF	Chrysotile	Not Available	Non-friable	Poor

5.6 POLYCHLORINATED BIPHENYL

The files available for review during this investigation did not indicate any known polychlorinated biphenyl (PCB) contamination or documentation of transformers containing PCB-oil that have been reported at the N&MCRC site. There are two transformers located between the Administration Building and the Vehicle Maintenance Building. The transformers are in operation but do not contain PCB-oil.

Section 5 Findings

5.7 RADON GAS

DoD policy is to ensure that any available and relevant radon assessment data pertaining to BRAC property being transferred shall be included in property transfer documents, however no relevant data exist for the N&MCRC. Without the data, it is also DoD policy not to perform radon assessment and mitigation prior to transfer of BRAC property unless otherwise required by applicable law (BRAC, 1994). Therefore, the determination of the presence of radon does not preclude the transfer of the property.

5.8 RADIOACTIVE WASTES

The files reviewed for this investigation did not indicate any known radioactive contamination nor do they contain historical documentation of radioactive materials being reported at the N&MCRC site.

5.9 WASTEWATER DISCHARGES

The files reviewed for this investigation indicate wastewater discharges from industrial practices at the N&MCRC are restricted to the Oil-Water Separator (OWS), located southeast of the Vehicle Washrack.

The OWS receives an oily water mixture from the nearby Vehicle Washrack. The Vehicle Washrack area is bermed and is approximately 20 feet long and 20 feet wide. This area centrally drains into a subsurface pipe that connects to the OWS. The OWS is a double-walled, steel, three-stage separator with a total capacity of 1,000 gallons. The OWS is connected to the Los Angeles City Bureau of Sanitation (LACBS) sanitary sewer line located on Bernard Street approximately 20 feet south of the southern gate. At the point where water leaves N&MCRC property, LACBS diverts the flow to the Hyperion Water Reclamation Plant for treatment. (Appendix D).

A Notice of Intent (NOI) to operate the OWS was filed with the DTSC on 7 May 1992, followed by a revised filing on 3 March 1993. A permit fee for Conditionally Exempt-Small Quantity Treatment (Tier V) was submitted to DTSC along with the 1993 NOI.

A site survey was performed to facilitate hazardous waste tiered permitting for hazardous materials at the N&MCRC. During the survey, influent from the OWS was sampled and analyzed for hazardous characteristics. The analytical results concluded the influent was not hazardous (ERM-West).

Storm water is an additional potential source of wastewater discharges. Storm water issues are addressed in the Storm Water Discharge Management Plan for the N&MCRC (N&MCRC, 1993). No storm water discharge violations have been documented at the N&MCRC.

5.10 RELATED ENVIRONMENTAL CONCERNS

The following sections discuss other related environmental concerns at the N&MCRC site.

Section 5 Findings

5.10.1 Landfills

None of the records reviewed nor visually inspected during this investigation, indicate that N&MCRC property has been used as a landfill. In addition, records reviewed and visual inspection of the properties adjacent to the N&MCRC indicate no landfills are located, or were adjacent to the N&MCRC facility.

5.10.2 Wetlands/Floodplains

Based on information provided by the U.S. Army Corps of Engineers, there does not appear to be wetlands or floodplains within a 1-mile radius of the N&MCRC site (Appendix D)

5.10.3 Prime or Unique Farmlands

Based on the maps and records reviewed during this investigation and visual inspections, there appear to be no prime or unique farmlands within a 1-mile radius of the N&MCRC.

5.10.4 Ordnance

From the files reviewed during this investigation, there are two areas of environmental concern related to equipment and supplies for Naval warfare (artillery and small arms ammunition) at the N&MCRC. These areas include the following:

- Small Arms Firing Range located in the Administration Building, and
- Large Artillery Weapons located in the Administration Building.

The Small Arms Firing Range is located in the basement of the Administration Building. The firing range was used for pistol and rifle firing practice. A sand pit with lead bullet fragments is located beneath the backstop of the firing range. The pit is approximately 45 feet long, 3 feet wide, and 1-foot deep. The pit is concrete bermed on all sides, with a concrete base. The bermed structure does not allow for any migration of potentially hazardous materials. Two banks of air vents are located in the firing range room; one directly above the pit and one at the mid-point of the firing range room.

Two large artillery weapons are located in the Administration Building gymnasium. The weapons were used for training purposes, but were not fired. The hydraulic system for each weapon is contained aboveground. The hydraulic lines were supplied with oil from a reservoir with a capacity of approximately 3 gallons. Officials from the City of Los Angeles Fire Department reported the hydraulic system was drained by the Navy before the fire department took occupancy of the facility (Appendix D). There is a trench approximately 25 feet long, 1-foot wide and 4 inches deep leading to each weapon platform. The trenches formerly housed the electrical wiring for each gun. The guns have been rendered inoperable.

Section 5 Findings

5.10.5 Historical/Cultural Resources

There are two designated State of California Historic Landmarks on the N&MCRC facility grounds. These landmarks consist of the following:

- Administration Building, and
- Open Field Area located above the N&MCRC compound

The N&MCRC administration building was dedicated as a State of California Historical Landmark on 19 September 1987. The building was designed as the largest enclosed structure without columns in the world. The facility is also known as the largest and second oldest Naval Reserve training center in the United States (N&MCRC, 1987).

The Open Field area located above the N&MCRC compound was identified on a Los Angeles County Assessor's Office subdivision tract map as the location of a "Hebrew Cemetery." The former cemetery site was exhumed in 1910. The site is recognized as the "First Jewish Site In Los Angeles" established in 1854 (California Department of Parks and Recreation, State Historic Preservation Office, 1995).

There have been no archaeological sites identified on the N&MCRC property (Los Angeles City Planning Department, 1981).

5.10.6 Threatened or Endangered Species

A site investigation for threatened or endangered species was performed by a DON, SWDIV Fish and Wildlife Biologist on 9 March 1995. During the investigation no known federal or State of California listed threatened or endangered species were encountered. It was recommended that a herpetological survey be performed if any intrusive work was planned in the landscaped areas (Appendix F).

5.10.7 Ongoing Environmental Response Actions

There are no ongoing environmental response actions taking place at the N&MCRC or adjacent to the facility.

Section 6 CONCLUSIONS

This CERFA EBS was conducted by compiling existing available sources of historical and current information about the N&MCRC. The basis for evaluating the N&MCRC property was to review readily available reports, surveys, inspections, drawings, and aerial photographs and to conduct interviews with N&MCRC personnel. Evidence of past operations, construction or other activity was used to determine potential types or sources of environmental concern.

The facility was mapped in accordance with the seven EBS Facility Findings Area Types (Table 1-1). Figure 6-1 is a present-day site plot plan with associated overlays defining these areas. The N&MCRC buildings and grounds are depicted in overlay one. The shaded areas in overlay two indicate the areas of concern as described in this report. Incorporated into these shaded areas and surrounding the areas of concern are areas of uncertainty that provide allowances for the possible migration of chemicals from known, likely, or potential areas of concern. The following sections present the conclusions of the EBS according to each area type.

6.1 EBS FACILITY FINDINGS AREA TYPE 1

All N&MCRC site locations not designated as EBS Facility Findings Area Type 2, 4, or 7 have been identified as EBS Facility Findings Area Type 1, *Areas where no storage, release, or disposal of hazardous substances or petroleum products has occurred, including no migration of these substances from adjacent areas.*

The Administration building is classified as EBS Facility Findings Area Type 1, with the exception of the Small Arms Firing Range. Portions of the Open Field area on the east side of the property, the Oil-Water Separator, and the Vehicle Maintenance Building is also classified as EBS Facility Findings Area Type 1. An explanation of criteria for classifying these areas as Area Type 1 is discussed below:

Administration Building

- **Asbestos Containing Materials.** The asbestos survey conducted in November 1992 identified ACM in plaster on the Administration Building basement walls, vinyl floor tiles in the basement laboratory, and the east end of the 2nd floor Administration Building tower. All ACM will be removed prior to property transfer.
- **Lead-based Paint.** The paint used in the Administration building may contain lead-based materials. The area of concern in the basement area will be abated in conjunction with the ACM.
- **Large Artillery Hydraulic Lines.** The potential for a release of hydraulic oil from the weapons to the subsurface is very low. The hydraulic oil was circulated within a closed system contained above ground. There is no evidence of spillage or staining on the gymnasium floor.

Section 6 Conclusions

Open Field Area

The areas labeled Open Field, 'Earth', 'U S.M.C. Band Hut', and 'A.C. Paving' show no signs of disposal, spillage or staining. All paved areas are in good condition.

Oil-Water Separator

The City of Los Angeles Fire Department will use the Oil-Water Separator when transfer of the property is completed. Proper permitting of the structure will be required through the Los Angeles Sanitation Bureau for future use.

Vehicle Maintenance Building

The Vehicle Maintenance Building is classified as EBS Facility Findings Area Type 1. The subsurface area beneath the building will be classified as EBS Facility Findings Area Type 7 due to the possible existence of the former service station UST.

EBS Facility Findings Area Type 1 are identified by the color white on Overlay 2 of Figure 6-1.

6.2 EBS FACILITY FINDINGS AREA TYPE 2

Based on the findings from this investigation, the following areas were identified as EBS Facility Findings Area Type 2, *Areas where only storage of hazardous substances or petroleum products has occurred; but, no release, disposal, or migration from adjacent areas has occurred:*

- **Hazardous Substance Storage Area.** The Hazardous Substance Storage Area was constructed in 1990. The storage area is bermed and no documentation regarding spills or releases from the area were found in the files and information provided by the U.S. Navy.
- **Paint Shed in the Open Field Area.** The pad and building floor of the Paint Shed show no signs of weathering, spillage or staining. A small quantity of solidified roofing material has been spread out onto the pad next to the Paint Shed. The concrete floor of the shed is in good condition, with only one hairline crack in the middle of the floor.

EBS Facility Findings Area Type 2 is identified by the color blue on Overlay 2 of Figure 6-1

6.3 EBS FACILITY FINDINGS AREA TYPE 3

Based on the findings from this investigation, there are no areas identified as EBS Facility Findings Area Type 3, *Areas where storage release, disposal, and/or disposal of hazardous substances or petroleum products has occurred, but at concentrations that do not require a removal or remedial action.*

Section 6 Conclusions

6.4 EBS FACILITY FINDINGS AREA TYPE 4

Based on the findings from this investigation, the former Waste-Oil UST location has been identified as EBS Facility Findings Area Type 4 - *Areas where storage, release, disposal, and/or migration of hazardous substances or petroleum products has occurred, and all remedial actions necessary to protect human health and the environment have been taken.*

The former Waste-Oil UST was excavated and removed on 9 November 1994. SWDIV confirmed the closure of the former Waste-Oil UST site with the City of Los Angeles Fire Prevention Bureau who oversees UST removal actions for the City of Los Angeles. The recommendation of no further remedial action, as reported in the UST closure report, was accepted by the Fire Department.

EBS Facility Findings Area Type 4 is identified by the color dark green on Overlay 2 of Figure 6-1

6.5 EBS FACILITY FINDINGS AREA TYPE 5

Based on the findings from this investigation, there are no areas identified as EBS Facility Findings Area Type 5 - *Areas where storage, release, disposal, and/or migration of hazardous substances or petroleum products has occurred, removal and/or remedial actions are underway, but all required remedial actions have not yet been taken.*

6.6 EBS FACILITY FINDINGS AREA TYPE 6

Based on the findings from this investigation there are no areas identified as EBS Facility Findings Area Type 6 - *Areas where storage, release, disposal, and/or migration of hazardous substances or petroleum products has occurred, but required response actions have not yet been implemented.*

6.7 EBS FACILITY FINDINGS AREA TYPE 7

Based on the findings from this investigation, the following areas have been identified as EBS Facility Findings Area Type 7 - *Areas that are unevaluated or require additional evaluation:*

- Vehicle Luberack Area. Hazardous materials formerly stored in the Luberack Area could have potentially been released into the subsurface from past storage practices. A shallow subsurface soil investigation is planned in this area to determine if potential hazardous material releases have occurred.
- Former Location of the Service Station. There is no documentation that the gasoline UST and associated piping were removed from this location. Therefore, a geophysical survey is will be conducted in the area of the present day Vehicle Maintenance Building and Luberack Area to confirm its removal.

APPENDIX B

LADPW WATER WELL REPORTS

LOS ANGELES COUNTY
FLOOD CONTROL DISTRICT
Water Conservation Division
WELL DATA

Owner: LOS ANGELES COUNTY FLOOD CONTROL DISTRICT

Location and Description: S.E. North of North curb of Beverly Blvd., 84' E. West of West curb of Commonwealth Ave., City of Los Angeles

Use: Groundwater Observation

Elev. of average gtd. at well: 288.45' U.S.G.S. Datum

Elev. of gtd. adjacent to well: U.S.G.S. Datum

Water surface reference points:

(a) From 11-7-73 To: Elev. 288.2' How det'd: levels

Description: Top of 2" plug to 4" pipe vault

(b) From: To: Elev. How det'd

Description:

(c) From: To: Elev. How det'd

Description:

(d) From: To: Elev. How det'd

Description:

Type of well: Rotary drilled Site: 2"

Original depth: 47' Soundings: 46.7' - 41-12-23

Pumping equipment: NONE 43.8' - 4-4-74

Power used: NONE

Capacity: Drawdown:

Date drilled: 11-7-73 by LACFD

Artesian characteristics:

Quality of water:

Remarks:

(over)

Well Numbers

Owner

D.W.R.

18/13A-19C01

D.W.R.

Loc.

F.C. 2712A

LOG WELL No. 2760

Drilled by *Tomson*

Date drilled *Jan. 6 1920*

Depth from ground surface *107½*

Struck water at *ft. from ground.*

Water rose to *ft. from ground.*

FROM TO		CLASSIFICATION OF MATERIALS
0	27	Sand
27	54	Gravel
54	56	Clay
56	58	Sand
58	80	Cement Gravel
80	107½	Boulders

LOG OF WELL NO. 277/I

Drilled by Victor L. ...

Date drilled: 7-2-57

Depth from ground surface

Struck water at ft. from ground.

Water rose to ft. from ground.

FROM	TO	CLASSIFICATION OF MATERIALS
0	0	10' - 20' - 30' - 40' - 50' - 60' - 70' - 80' - 90' - 100'
0	10	0.5% - 1.0% - 1.5% - 2.0% - 2.5% - 3.0% - 3.5% - 4.0% - 4.5% - 5.0%
10	20	5.0% - 5.5% - 6.0% - 6.5% - 7.0% - 7.5% - 8.0% - 8.5% - 9.0% - 9.5%
20	30	10.0% - 10.5% - 11.0% - 11.5% - 12.0% - 12.5% - 13.0% - 13.5% - 14.0% - 14.5%
30	40	15.0% - 15.5% - 16.0% - 16.5% - 17.0% - 17.5% - 18.0% - 18.5% - 19.0% - 19.5%
40	50	20.0% - 20.5% - 21.0% - 21.5% - 22.0% - 22.5% - 23.0% - 23.5% - 24.0% - 24.5%
50	60	25.0% - 25.5% - 26.0% - 26.5% - 27.0% - 27.5% - 28.0% - 28.5% - 29.0% - 29.5%
60	70	30.0% - 30.5% - 31.0% - 31.5% - 32.0% - 32.5% - 33.0% - 33.5% - 34.0% - 34.5%
70	80	35.0% - 35.5% - 36.0% - 36.5% - 37.0% - 37.5% - 38.0% - 38.5% - 39.0% - 39.5%
80	90	40.0% - 40.5% - 41.0% - 41.5% - 42.0% - 42.5% - 43.0% - 43.5% - 44.0% - 44.5%
90	100	45.0% - 45.5% - 46.0% - 46.5% - 47.0% - 47.5% - 48.0% - 48.5% - 49.0% - 49.5%
100	110	50.0% - 50.5% - 51.0% - 51.5% - 52.0% - 52.5% - 53.0% - 53.5% - 54.0% - 54.5%
110	120	55.0% - 55.5% - 56.0% - 56.5% - 57.0% - 57.5% - 58.0% - 58.5% - 59.0% - 59.5%
120	130	60.0% - 60.5% - 61.0% - 61.5% - 62.0% - 62.5% - 63.0% - 63.5% - 64.0% - 64.5%
130	140	65.0% - 65.5% - 66.0% - 66.5% - 67.0% - 67.5% - 68.0% - 68.5% - 69.0% - 69.5%
140	150	70.0% - 70.5% - 71.0% - 71.5% - 72.0% - 72.5% - 73.0% - 73.5% - 74.0% - 74.5%
150	160	75.0% - 75.5% - 76.0% - 76.5% - 77.0% - 77.5% - 78.0% - 78.5% - 79.0% - 79.5%
160	170	80.0% - 80.5% - 81.0% - 81.5% - 82.0% - 82.5% - 83.0% - 83.5% - 84.0% - 84.5%
170	180	85.0% - 85.5% - 86.0% - 86.5% - 87.0% - 87.5% - 88.0% - 88.5% - 89.0% - 89.5%
180	190	90.0% - 90.5% - 91.0% - 91.5% - 92.0% - 92.5% - 93.0% - 93.5% - 94.0% - 94.5%
190	200	95.0% - 95.5% - 96.0% - 96.5% - 97.0% - 97.5% - 98.0% - 98.5% - 99.0% - 99.5%
200	210	100.0% - 100.5% - 101.0% - 101.5% - 102.0% - 102.5% - 103.0% - 103.5% - 104.0% - 104.5%
210	220	105.0% - 105.5% - 106.0% - 106.5% - 107.0% - 107.5% - 108.0% - 108.5% - 109.0% - 109.5%
220	230	110.0% - 110.5% - 111.0% - 111.5% - 112.0% - 112.5% - 113.0% - 113.5% - 114.0% - 114.5%
230	240	115.0% - 115.5% - 116.0% - 116.5% - 117.0% - 117.5% - 118.0% - 118.5% - 119.0% - 119.5%
240	250	120.0% - 120.5% - 121.0% - 121.5% - 122.0% - 122.5% - 123.0% - 123.5% - 124.0% - 124.5%
250	260	125.0% - 125.5% - 126.0% - 126.5% - 127.0% - 127.5% - 128.0% - 128.5% - 129.0% - 129.5%
260	270	130.0% - 130.5% - 131.0% - 131.5% - 132.0% - 132.5% - 133.0% - 133.5% - 134.0% - 134.5%
270	280	135.0% - 135.5% - 136.0% - 136.5% - 137.0% - 137.5% - 138.0% - 138.5% - 139.0% - 139.5%
280	290	140.0% - 140.5% - 141.0% - 141.5% - 142.0% - 142.5% - 143.0% - 143.5% - 144.0% - 144.5%
290	300	145.0% - 145.5% - 146.0% - 146.5% - 147.0% - 147.5% - 148.0% - 148.5% - 149.0% - 149.5%
300	310	150.0% - 150.5% - 151.0% - 151.5% - 152.0% - 152.5% - 153.0% - 153.5% - 154.0% - 154.5%
310	320	155.0% - 155.5% - 156.0% - 156.5% - 157.0% - 157.5% - 158.0% - 158.5% - 159.0% - 159.5%
320	330	160.0% - 160.5% - 161.0% - 161.5% - 162.0% - 162.5% - 163.0% - 163.5% - 164.0% - 164.5%
330	340	165.0% - 165.5% - 166.0% - 166.5% - 167.0% - 167.5% - 168.0% - 168.5% - 169.0% - 169.5%
340	350	170.0% - 170.5% - 171.0% - 171.5% - 172.0% - 172.5% - 173.0% - 173.5% - 174.0% - 174.5%
350	360	175.0% - 175.5% - 176.0% - 176.5% - 177.0% - 177.5% - 178.0% - 178.5% - 179.0% - 179.5%
360	370	180.0% - 180.5% - 181.0% - 181.5% - 182.0% - 182.5% - 183.0% - 183.5% - 184.0% - 184.5%
370	380	185.0% - 185.5% - 186.0% - 186.5% - 187.0% - 187.5% - 188.0% - 188.5% - 189.0% - 189.5%
380	390	190.0% - 190.5% - 191.0% - 191.5% - 192.0% - 192.5% - 193.0% - 193.5% - 194.0% - 194.5%
390	400	195.0% - 195.5% - 196.0% - 196.5% - 197.0% - 197.5% - 198.0% - 198.5% - 199.0% - 199.5%
400	410	200.0% - 200.5% - 201.0% - 201.5% - 202.0% - 202.5% - 203.0% - 203.5% - 204.0% - 204.5%
410	420	205.0% - 205.5% - 206.0% - 206.5% - 207.0% - 207.5% - 208.0% - 208.5% - 209.0% - 209.5%
420	430	210.0% - 210.5% - 211.0% - 211.5% - 212.0% - 212.5% - 213.0% - 213.5% - 214.0% - 214.5%
430	440	215.0% - 215.5% - 216.0% - 216.5% - 217.0% - 217.5% - 218.0% - 218.5% - 219.0% - 219.5%
440	450	220.0% - 220.5% - 221.0% - 221.5% - 222.0% - 222.5% - 223.0% - 223.5% - 224.0% - 224.5%
450	460	225.0% - 225.5% - 226.0% - 226.5% - 227.0% - 227.5% - 228.0% - 228.5% - 229.0% - 229.5%
460	470	230.0% - 230.5% - 231.0% - 231.5% - 232.0% - 232.5% - 233.0% - 233.5% - 234.0% - 234.5%
470	480	235.0% - 235.5% - 236.0% - 236.5% - 237.0% - 237.5% - 238.0% - 238.5% - 239.0% - 239.5%
480	490	240.0% - 240.5% - 241.0% - 241.5% - 242.0% - 242.5% - 243.0% - 243.5% - 244.0% - 244.5%
490	500	245.0% - 245.5% - 246.0% - 246.5% - 247.0% - 247.5% - 248.0% - 248.5% - 249.0% - 249.5%
500	510	250.0% - 250.5% - 251.0% - 251.5% - 252.0% - 252.5% - 253.0% - 253.5% - 254.0% - 254.5%
510	520	255.0% - 255.5% - 256.0% - 256.5% - 257.0% - 257.5% - 258.0% - 258.5% - 259.0% - 259.5%
520	530	260.0% - 260.5% - 261.0% - 261.5% - 262.0% - 262.5% - 263.0% - 263.5% - 264.0% - 264.5%
530	540	265.0% - 265.5% - 266.0% - 266.5% - 267.0% - 267.5% - 268.0% - 268.5% - 269.0% - 269.5%
540	550	270.0% - 270.5% - 271.0% - 271.5% - 272.0% - 272.5% - 273.0% - 273.5% - 274.0% - 274.5%
550	560	275.0% - 275.5% - 276.0% - 276.5% - 277.0% - 277.5% - 278.0% - 278.5% - 279.0% - 279.5%
560	570	280.0% - 280.5% - 281.0% - 281.5% - 282.0% - 282.5% - 283.0% - 283.5% - 284.0% - 284.5%
570	580	285.0% - 285.5% - 286.0% - 286.5% - 287.0% - 287.5% - 288.0% - 288.5% - 289.0% - 289.5%
580	590	290.0% - 290.5% - 291.0% - 291.5% - 292.0% - 292.5% - 293.0% - 293.5% - 294.0% - 294.5%
590	600	295.0% - 295.5% - 296.0% - 296.5% - 297.0% - 297.5% - 298.0% - 298.5% - 299.0% - 299.5%
600	610	300.0% - 300.5% - 301.0% - 301.5% - 302.0% - 302.5% - 303.0% - 303.5% - 304.0% - 304.5%
610	620	305.0% - 305.5% - 306.0% - 306.5% - 307.0% - 307.5% - 308.0% - 308.5% - 309.0% - 309.5%
620	630	310.0% - 310.5% - 311.0% - 311.5% - 312.0% - 312.5% - 313.0% - 313.5% - 314.0% - 314.5%
630	640	315.0% - 315.5% - 316.0% - 316.5% - 317.0% - 317.5% - 318.0% - 318.5% - 319.0% - 319.5%
640	650	320.0% - 320.5% - 321.0% - 321.5% - 322.0% - 322.5% - 323.0% - 323.5% - 324.0% - 324.5%
650	660	325.0% - 325.5% - 326.0% - 326.5% - 327.0% - 327.5% - 328.0% - 328.5% - 329.0% - 329.5%
660	670	330.0% - 330.5% - 331.0% - 331.5% - 332.0% - 332.5% - 333.0% - 333.5% - 334.0% - 334.5%
670	680	335.0% - 335.5% - 336.0% - 336.5% - 337.0% - 337.5% - 338.0% - 338.5% - 339.0% - 339.5%
680	690	340.0% - 340.5% - 341.0% - 341.5% - 342.0% - 342.5% - 343.0% - 343.5% - 344.0% - 344.5%
690	700	345.0% - 345.5% - 346.0% - 346.5% - 347.0% - 347.5% - 348.0% - 348.5% - 349.0% - 349.5%
700	710	350.0% - 350.5% - 351.0% - 351.5% - 352.0% - 352.5% - 353.0% - 353.5% - 354.0% - 354.5%
710	720	355.0% - 355.5% - 356.0% - 356.5% - 357.0% - 357.5% - 358.0% - 358.5% - 359.0% - 359.5%
720	730	360.0% - 360.5% - 361.0% - 361.5% - 362.0% - 362.5% - 363.0% - 363.5% - 364.0% - 364.5%
730	740	365.0% - 365.5% - 366.0% - 366.5% - 367.0% - 367.5% - 368.0% - 368.5% - 369.0% - 369.5%
740	750	370.0% - 370.5% - 371.0% - 371.5% - 372.0% - 372.5% - 373.0% - 373.5% - 374.0% - 374.5%
750	760	375.0% - 375.5% - 376.0% - 376.5% - 377.0% - 377.5% - 378.0% - 378.5% - 379.0% - 379.5%
760	770	380.0% - 380.5% - 381.0% - 381.5% - 382.0% - 382.5% - 383.0% - 383.5% - 384.0% - 384.5%
770	780	385.0% - 385.5% - 386.0% - 386.5% - 387.0% - 387.5% - 388.0% - 388.5% - 389.0% - 389.5%
780	790	390.0% - 390.5% - 391.0% - 391.5% - 392.0% - 392.5% - 393.0% - 393.5% - 394.0% - 394.5%
790	800	395.0% - 395.5% - 396.0% - 396.5% - 397.0% - 397.5% - 398.0% - 398.5% - 399.0% - 399.5%
800	810	400.0% - 400.5% - 401.0% - 401.5% - 402.0% - 402.5% - 403.0% - 403.5% - 404.0% - 404.5%
810	820	405.0% - 405.5% - 406.0% - 406.5% - 407.0% - 407.5% - 408.0% - 408.5% - 409.0% - 409.5%
820	830	410.0% - 410.5% - 411.0% - 411.5% - 412.0% - 412.5% - 413.0% - 413.5% - 414.0% - 414.5%
830	840	415.0% - 415.5% - 416.0% - 416.5% - 417.0% - 417.5% - 418.0% - 418.5% - 419.0% - 419.5%
840	850	420.0% - 420.5% - 421.0% - 421.5% - 422.0% - 422.5% - 423.0% - 423.5% - 424.0% - 424.5%
850	860	425.0% - 425.5% - 426.0% - 426.5% - 427.0% - 427.5% - 428.0% - 428.5% - 429.0% - 429.5%
860	870	430.0% - 430.5% - 431.0% - 431.5% - 432.0% - 432.5% - 433.0% - 433.5% - 434.0% - 434.5%
870	880	435.0% - 435.5% - 436.0% - 436.5% - 437.0% - 437.5% - 438.0% - 438.5% - 439.0% - 439.5%
880	890	440.0% - 440.5% - 441.0% - 441.5% - 442.0% - 442.5% - 443.0% - 443.5% - 444.0% - 444.5%
890	900	445.0% - 445.5% - 446.0% - 446.5% - 447.0% - 447.5% - 448.0% - 448.5% - 449.0% - 449.5%
900	910	450.0% - 450.5% - 451.0% - 451.5% - 452.0% - 452.5% - 453.0% - 453.5% - 454.0% - 454.5%
910	920	455.0% - 455.5% - 456.0% - 456.5% - 457.0% - 457.5% - 458.0% - 458.5% - 459.0% - 459.5%
920	930	460.0% - 460.5% - 461.0% - 461.5% - 462.0% - 462.5% - 463.0% - 463.5% - 464.0% - 464.5%
930	940	465.0% - 465.5% - 466.0% - 466.5% - 467.0% - 467.5% - 468.0% - 468.5% - 469.0% - 469.5%
940	950	470.0% - 470.5% - 471.0% - 471.5% - 472.0% - 472.5% - 473.0% - 473.5% - 474.0% - 474.5%
950	960	475.0% - 475.5% - 476.0% - 476.5% - 477.0% - 477.5% - 478.0% - 478.5% - 479.0% - 479.5%
960	970	480.0% - 480.5% - 481.0% - 481.5% - 482.0% - 482.5% - 483.0% - 483.5% - 484.0% - 484.5%
970	980	485.0% - 485.5% - 486.0% - 486.5% - 487.0% - 487.5% - 488.0% - 488.5% - 489.0% - 489.5%
980	990	490.0% - 490.5% - 491.0% - 491.5% - 492.0% - 492.5% - 493.0% - 493.5% - 494.0% - 494.5%
990	1000	495.0% - 495.5% - 496.0% - 496.5% - 497.0% - 497.5% - 498.0% - 498.5% - 499.0% - 499.5%
1000	1010	500.0% - 500.5% - 501.0% - 501.5% - 502.0% - 502.5% - 503.0% - 503.5% - 504.0% - 504.5%
1010	1020	505.0% - 505.5% - 506.0% - 506.5% - 507.0% - 507.5% - 508.0% - 508.5% - 509.0% - 509.5%
1020	1030	510.0% - 510.5% - 511.0% - 511.5% - 512.0% - 512.5% - 513.0% - 513.5% - 514.0% - 514.5%
1030	1040	515.0% - 515.5% - 516.0% - 516.5% - 517.0% - 517.5% - 518.0% - 518.5% - 519.0% - 519.5%
1040	1050	520.0% - 520.5% - 521.0% - 521.5% - 522.0% - 522.5% - 523.0% - 523.5% - 524.0% - 524.5%
1050	1060	525.0% - 525.5% - 526.0% - 526.5% - 527.0% - 527.5% - 528.0% - 528.5% - 529.0% - 529.5%
1060	1070	530.0% - 530.5% - 531.0% - 531.5% - 532.0% - 532.5% - 533.0% - 533.5% - 534.0% - 534.5%
1070	1080	535.0% - 535.5% - 536.0% - 536.5% - 537.0% - 537.5% - 538.0% - 538.5% - 539.0% - 539.5%
1080	1090	540.0% - 540.5% - 541.0% - 541.5% - 542.0% - 542.5% - 543.0% - 543.5% - 544.0% - 544.5%
1090	1100	545.0% - 545.5% - 546.0% - 546.5% - 547.0% - 547.5% - 548.0% - 548.5% - 549.0% - 549.5%
1100	1110	550.0% - 550.5% - 551.0% - 551.5% - 552.0% - 552.5% - 553.0% - 553.5% - 554.0% - 554.5%
1110	1120	555.0% - 555.5% - 556.0% - 556.5% - 557.0% - 557.5% - 558.0% - 558.5% - 559.0% - 559.5%
1120	1130	560.0% - 560.5% - 561.0% - 561.5% - 562.0% - 562.5% - 563.0% - 563.5% - 564.0% - 564.5%
1130	1140	565.0% - 565.5% - 566.0% - 566.5% - 567.0% - 567.5% - 568.0% - 568.5% - 569.0% - 569.5%
1140	1150	570.0% - 570.5% - 571.0% - 571.5% - 572.0% - 572.5% - 573.0% - 573.5% - 574.0% - 574.5%
1150	1160	575.0% - 575.5% - 576.0% - 576.5% - 577.0% - 577.5% - 578.0% - 578.5% - 579.0% - 579.5%
1160	1170	580.0% - 580.5% - 581.0% - 581.5% - 582.0% - 582.5% - 583.0% - 583.5% - 584.0% - 584.5%
1170	1180	58

LOS ANGELES COUNTY
FLOOD CONTROL DISTRICT
HYDRAULIC DIVISION
WELL DATA

SHEET 1

Well Number: 1051 Well #9 Owner: D.W.R.
No. 13/3W-15R3 Loc. F.C. 2772D

Owner: L.A.D.W.R.

Location and Description: 100' SW of 300 Fernando Rd.,
50' SE of Lacy St.

GROUND WATER OBSERVATION

Elevation of well: 322.13' U.S.C.S. Datum

Elevation of gage adjacent to well: 322.13' U.S.C.S. Datum

Water surface reference points: Elev. 322.13' Has det. L.A.W.D.

(a) From Top of well casing

(b) From 4-27-59 To 327.40 Has det. L.A.W.D.

Description: Top of well casing (extended)

(c) From To Elev. 327.40

Description: To Elev. 327.40

(d) From To Elev. 327.40

Description: To Elev. 327.40

(e) From To Elev. 327.40

Description: To Elev. 327.40

(f) From To Elev. 327.40

Description: To Elev. 327.40

(g) From To Elev. 327.40

Description: To Elev. 327.40

(h) From To Elev. 327.40

Description: To Elev. 327.40

(i) From To Elev. 327.40

Description: To Elev. 327.40

(j) From To Elev. 327.40

Description: To Elev. 327.40

(k) From To Elev. 327.40

Description: To Elev. 327.40

(l) From To Elev. 327.40

Description: To Elev. 327.40

(m) From To Elev. 327.40

Description: To Elev. 327.40

(n) From To Elev. 327.40

Description: To Elev. 327.40

(o) From To Elev. 327.40

Description: To Elev. 327.40

(p) From To Elev. 327.40

Description: To Elev. 327.40

(q) From To Elev. 327.40

Description: To Elev. 327.40

(r) From To Elev. 327.40

Description: To Elev. 327.40

(s) From To Elev. 327.40

Description: To Elev. 327.40

(t) From To Elev. 327.40

Description: To Elev. 327.40

(u) From To Elev. 327.40

Description: To Elev. 327.40

(v) From To Elev. 327.40

Description: To Elev. 327.40

(w) From To Elev. 327.40

Description: To Elev. 327.40

(x) From To Elev. 327.40

Description: To Elev. 327.40

(y) From To Elev. 327.40

Description: To Elev. 327.40

(z) From To Elev. 327.40

Description: To Elev. 327.40

(aa) From To Elev. 327.40

Description: To Elev. 327.40

(ab) From To Elev. 327.40

Description: To Elev. 327.40

(ac) From To Elev. 327.40

Description: To Elev. 327.40

(ad) From To Elev. 327.40

Description: To Elev. 327.40

(ae) From To Elev. 327.40

Description: To Elev. 327.40

(af) From To Elev. 327.40

Description: To Elev. 327.40

(ag) From To Elev. 327.40

Description: To Elev. 327.40

(ah) From To Elev. 327.40

Description: To Elev. 327.40

(ai) From To Elev. 327.40

Description: To Elev. 327.40

(aj) From To Elev. 327.40

Description: To Elev. 327.40

(ak) From To Elev. 327.40

Description: To Elev. 327.40

Type of well: III' Soundings:

Original depth: III'

Pumping equipment:

Power used:

Capacity:

Date drilled: 8-21-1958 By L.A.D.W.R. Fred Alexander

Attenuation characteristics:

Quality of water:

Remarks: Data from State Meter Flight's Brand A-22-40.

LOG OF WELL NO. 2772D

FROM	TO	CLASSIFICATION OF MATERIALS	TO	CLASSIFICATION OF MATERIALS
------	----	-----------------------------	----	-----------------------------

70-86

[illegible]

after 2000

1991

ACCU. NIB
HYDRAULIC
WELL

Owner: *L.A.D. W&P*

Location and Description: *45' E. of Exp. Curd Ave. 19,
55' E. & of Lucy St.*

Use: *Test Well*

Elev. of average grd. at well: *3201.32/31*

Elev. of grd. adjacent to well:

Water surface reference points:
(a) From *126.60* To *Elev. 321.31* How det. *LAND LEVELS*
Description: *Top of casing @ 9' and*

(b) From	To	Elev.	How det.
Description:			
(c) From	To	Elev.	How det.
Description:			
(d) From	To	Elev.	How det.
Description:			

Type of well:

Original depth: *55'*

Soundings:

Pumping equipment:

Power used:

Capacity: Drawdown:

Date drilled: *4-15-1958* by *L.A.D. W&P - Fred Alexander*

Artesian characteristics:

Quality of water:

Remarks: *Data from State Water Rights Board 4-22-60*

(over)

Owner

D. W. R.

D. W. R.

Numbers

No.

Loc.

F. C.

2772 E

Well Numbers

LOS ANGELES COUNTY
FLOOD CONTROL DISTRICT
HYDRAULIC DEPARTMENT
WELL DATA

Location and description *So. of Alhambra Ave.,
E. of N. H. St. N.E. cor. 2400' ± S.E. of the E. Abutment of the
S. P. Co's bridge (200' ± S.E. of the E. Abutment of the
S. P. Co's bridge) S. P. Bridge of Alhambra & LA*

Description of reference point (a) *0.5' above gnd.*
(b) *5-6-47 Highline hole in N.E. corner of property, 0.5'
above gnd.*

R. P. elev. above sea level *(a) 458.5*

How determined *(a) R.R. & F.A.W.D.*

R. P. elev. above, below, ground level *(b) 0.5' above gnd.*

Owner *So. Pacific R.R.*

Use *None-capped*

Capacity of well

Depth of well *99'*

Size of well *24" dia. (Backfilled 5-6-47)*

Power used

Type of motor, engine

Type of pump *Removed*

Capacity of pump *1500 GPM 5-6-47*

Year drilled or dug *1913*

Depth to water when drilled

Salinity of water

Temperature of water

Artesian when drilled

Artesian on date

*R.R. (C) 1-18-65 Top of 2" man. pipe,
at gnd. surface. Elev. 296.4' owner's
level*

JNR
15/1317-22R1F. C. Well No *2773*

LOG OF WELL NO. 2773

Drilled by:

Politicizing Debt

Lent from ground surface

Shack water at ft. from ground.

Water rose in	ft. from ground.
---------------------	--------	------------------

[illegible]

THE 4" GALEEN WAS DUG AT RIGHT ANGLES TO THE
WELL IN AN ATTEMPT TO TAP THE L.A. RIVER,
BUT INSTEAD TAPPED A SUBURB STREAM,
WHICH MAKES THIS WELL UNSALVABLE. ESB 12-8-47

APPENDIX E

FORMER WASTE-OIL UST TANK CLOSURE REPORT

Amwest Environmental

28 Centerpointe Drive, Suite 100, La Palma, CA 90623-1054 U.S.A.
Telephone (714)228-2088; FAX: (714)228-2099

Project No. CO 4032
TANK CLOSURE REPORT

FOR

Naval & Marine Corps Reserve Center
1700 Stadium Way
Los Angeles, California 90012

Prepared for:


Department of the Navy
Southwest Division
Naval Facilities Engineering Command
1220 Pacific Highway
San Diego, CA 92132-5187

Submitted to:

City of Los Angeles Fire Department
200 North Main Street
Los Angeles, California 90012

Prepared by:

Amwest Environmental Engineering


Jerry Huang, Ph.D. & P.E.
Vice President

February, 1995

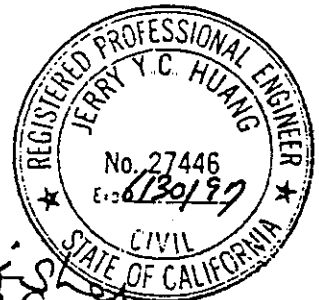
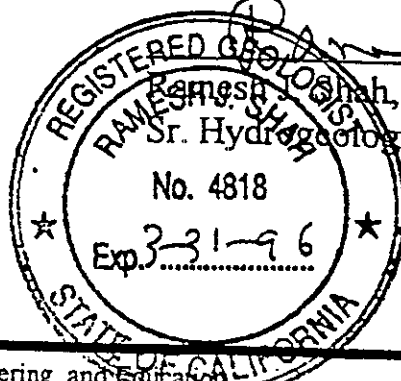


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Appendix B	Certificate of Analysis (QA/QC) Chain-of-Custody Forms

ABBREVIATIONS AND ACRONYMS

B	Benzene
bgs	Below Ground Surface (level)
CRWQCB	California Regional Water Quality Control Board (Los Angeles Region)
DOHS	(California) Department of Health Services (now Department of Toxic Substances Control)
E	Ethylbenzene
Elev.	Elevation
EPA	(United States, Federal) Environmental Protection Agency
Fig.	Figure(s)
ft.	Foot or feet
gal	Gallon(s)
in.	inch(es)
LEL	Lower Explosive Limit
mg/kg	milligram per kilogram
MSL	Mean Sea Level
NA	Not analyzed
ND	Not detected
OVA	Organic Vapor Analyzer
PID	Photo Ionization Detector
ppm	Parts per million (approximately mg/kg)
Ref.	Reference(s)
QA/QC	Quality Assurance/Quality Control
T	Toluene
TPH	Total Petroleum Hydrocarbon
TRPH	Total Recoverable Petroleum Hydrocarbon
ug/kg	microgram per kilogram
USCS	Unified Soil Classification System
USGS	United States Geological Survey
UST	Underground Storage Tank(s)
VOC	Volatile Organic Compound(s)
X	Xylenes (total)

1.0 INTRODUCTION

Amwest Environmental Engineering (Amwest) has been retained by The Department of the Navy, Southwest Division, Naval Facilities Engineering Command, 1220 Pacific Highway, San Diego, California, to remove one 2,000 gallon capacity underground storage tank (UST) and its associated pipes, and prepare a closure report. The tank was located at the Marine Corps Reserve Center, 1700 Stadium Way, Los Angeles California 90012 (Figure 1 Site Location Map)

This report presents the tank information with background of the tank, tank preparation and tank removal procedures, soil sampling, laboratory analysis of samples, site geology, hydrogeology, post excavation, remediation, and conclusions and recommendations based on the results of the analysis.

2.0 TANK INFORMATION

The tank was located near the vehicle maintenance building, adjacent to a concrete ramp, on the east side of the property at the Marine Corps Reserve Center (Figure 2 Site Plan). The tank was used to store the waste oil generated from vehicle maintenance.

The 2,000 gallon capacity tank was made of double wall steel, and was installed in the 1990's. The tank information summary is presented in Table 1.

Table 1
Tank Information
Marine Corps Reserve Center
1700 Stadium Way
Los Angeles, California 90012

Tank No.	Capacity (gallons)	Former use	Type of tank	Remark
1	2,000	Waste oil	Double wall steel	None

The tank was approximately twelve (12) feet in length and five (5) feet in diameter, and it was located approximately eight (8) feet away from the concrete ramp shown in Figure 2. The bottom of the tank was about ten (10) feet below the ground surface (bgs), and it contained approximately five (5) inches of waste oil.

3.0 TANK PREPARATION

This section presents the tank removal permit and tank preparation procedure.

3.1 Permit

On October 28, 1994, the City of Los Angeles Fire Department, issued a permit (Number 3993) for a tank removal. Tank removal operations were performed according to permit requirements. A copy of the permit is included in Appendix A. The work was performed by Amwest Environmental Engineering Company, La Palma, California, under the supervision of Ramesh Shah, R.G. Amwest Environmental Engineering holds a California State Contractors License Classifications A, B, and Hazardous Substance Removal.

2 Tank Preparation

On November 9, 1994, the tank's residual contents (waste oil) were removed and transported with a Uniform Hazardous Waste Manifest (No. 93239943) to Demenno Kerdoon facility in Compton, California, for treatment. A copy of the manifest is included in Appendix A.

4.0 TANK REMOVAL

On November 9, 1994, the tank and associated pipes were excavated using a backhoe. The excavation work was performed in the presence of Mr. Sparks, fire inspector and Underground Storage Tank Specialist for the City of Los Angeles Fire Department. The excavated soil from the tank cavity and product lines was stockpiled near the rim of the excavation.

The tank was certified clean by a marine chemist from CTL Environmental Services (Certification No. 03876 in Appendix A). The fire inspector on site verified the percentage of LEL and the tank was lifted from the excavation.

When the tank was inspected and found in good condition with no signs of failure or holes. No identification tag was found on the tank. The tank was loaded onto a truck and shipped to D.W. Russel, Wilmington, California. The tank disposal form dated November 9, 1994, is included in Appendix A.

As for the SCAQMD excavation permit "Rule 1166", emissions were monitored using OVA detector (PID) during the soil excavation. The surface was checked frequently to determine whether volatile organic compounds (VOC) were being emitted directly from the soil. The PID results showed less than 50 ppm of VOC; therefore engineering measures were not taken during the excavation.

Once the tank was pulled out of the ground, Visqueen plastic liner was placed on the bottom of the pit. Then part of the excavation was backfilled with 3/4 inch imported crushed rocks, while the rest was temporarily backfilled with the spoil. This was done while waiting for the laboratory soil analysis results to avoid safety hazard that could result from the predicted rain. Once the laboratory results were available, the contaminated spoil was removed and disposed at an off-site facility, and the pit was refilled with 3/4 inch crushed

EPA method 8020 for Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX) Results of the analytical data are presented in Table 2

Table 2
Results of Soil Sample Analysis
Marine Corps Reserve Center
1700 Stadium Way
Los Angeles, California 90012

i) EPA Method 418.1 (TRPH)

Sample Identification No.	Results (mg/kg)
SP-1	7440
SP-2	1660
SO-1	ND
NO-2	ND
Method of Detection Limit	10

ii) EPA Method 8020 (BTEX)

Sample Identification No.	Benzene (ug/kg)	Toluene (ug/kg)	Ethylbenzene (ug/kg)	Xylenes (ug/kg)
SP-1	49.9	ND	ND	ND
SP-2	29.8	ND	ND	ND
SO-1	13.6	ND	ND	ND
NO-2	30.7	ND	ND	ND
Method Detection Limit	5	5	5	15

7.0 SITE GEOLOGY

The subject site is located in the Elysian Park area, east of Santa Monica Mountains of Transverse Range geomorphic province of California. The Elysian Park is located at the northern end of the Los Angeles Coastal Plain (D. L. Lamar, 1970, Geology of the Elysian Park-Repetto Hills Area, Los Angeles County, California. California Division of Mines and Geology, Special Report 101).

The site is at approximately 380 feet elevation above mean sea level (MSL), and it is located on a terrace area where the general slope is steep from north to south. The Los Angeles River is located just east of the subject site.

The geologic formation of the area is Triassic Puente (Tpss) formations. The Puente Formation consists of interbedded and interfingered sandstone, siltstone, shale and rarely conglomerate and conglomeratic sandstone. The strata in the area have west-northwest to east-southeast strike and dips to south-west. The north dipping Elysian park fault is located approximately one mile north of the subject site.

8.0 SITE HYDROGEOLOGY

The area surface water drains into Los Angeles River. The average annual precipitation in the area is approximately 13 inches (Griffith Park Nursery gauging station).

Groundwater level was obtained from the Hydrologic Information Section of the Department of Public Works (Personal communication with Mr. R. Brown, on January 19, 1995). The county well (Well No. 2772 E in the vicinity of the subject site) is located at the intersection of Nineteenth Avenue and Lacy, Los Angeles, California. The well had a water depth of 31.6 feet below the ground surface on May 2, 1994. The well has a ground surface elevation of 321 above MSL, compared to the subject site ground surface elevation of approximately 380 feet MSL. However, this well is located on the east side of the Los Angeles River which is the groundwater divide in the area. Therefore, water level information may not be applicable to the site. Based on physiography, geology and hydrology of the area, it could be concluded that there is no aquifer under the subject site, and groundwater if present would be local and under perched condition.

9.0 POST EXCAVATION

Base on geology, groundwater table, and regulatory requirements, the soil analytical results after tank removal were evaluated to determine if any additional soil excavation would be required.

The results of the soil samples (SO-1 and NO-2) below the tank invert showed non-detectable concentrations of TRPH, Toluene, Ethylbenzene and Xylenes, and very low concentrations of Benzene, 13.6 ug/kg and 30.7 ug/kg respectively at the methods detection limits. These results appear to suggest

Based on geology, groundwater table depth, and regulatory requirements, soil with such TRPH concentrations could not be left in place and is required to be remediated. Furthermore, according to inspector Sparks, even though the soil below the tank contained small concentrations of benzene, it does not have to be remediated since the benzene concentrations in the soil were below the limit of 100 ug/kg.

In concurrence with inspector Sparks of the City of Los Angeles Fire Department, it was recommended that the waste oil impacted soil be excavated and remediated at an off-site facility. This recommendation was accepted by Mr. Mike Kenney of the Department of the Navy.

10.0 SOIL REMEDIATION

On December 14, 1994, the contaminated backfilled soil was remediated by excavation and transported to Candelaria Environmental Co., a biotreatment facility located in Anza, California. The Non-Hazardous Materials Hauling Manifest, dated December, 14 1994 is included in Appendix A. The soil removal operation was performed in the presence of Mr. Sparks, Fire Inspector and Underground Tank Specialist.

11.0 CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Based on the field observations and analytical results, the following conclusions are made:

- The UST was properly removed and disposed of according to current regulations and permit requirements.
- Soil at the site is stiff, plastic clay (CL).
- Groundwater was not encountered during the excavation.

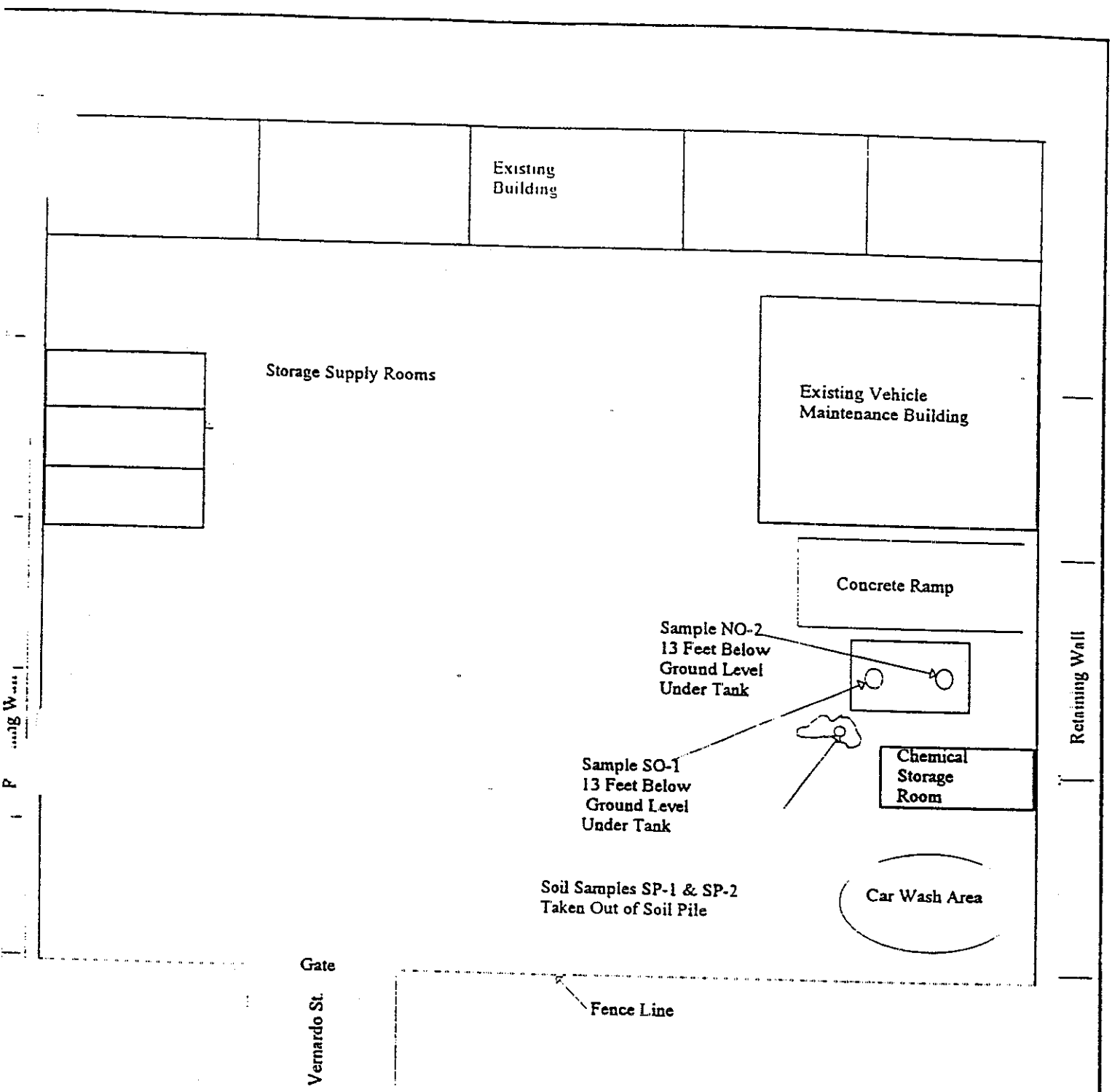
- Soil at the site is stiff plastic clay (CL)
- Groundwater was not encountered during the excavation
- Analytical results of the soil samples beneath the UST showed non-detectable , Toluene, Ethylbenzene, Xylenes, and TRPH; however, soil samples from the spoil exhibited high levels of TRPH. Also, Benzene concentration levels beneath and above the UST were within the acceptable limit.
- Waste oil impacted soil was removed and disposed of at a permitted biotreatment facility.
- The excavated cavity was backfilled and the area was resurfaced with concrete.

Recommendations:

Based on the analytical results of the soil samples from the base of the pit and removed soil, no further field investigation and remediation are recommended. A closure approval certificate from the Fire Prevention Bureau, Fire Department, City of Los Angeles, is requested.


FIGURES

- Figure 1 - Site Location Map
- Figure 2 - Plot Plan



Slope Direction



Plot Plan Marine Corps. Reserve Center 1700 Stadium Way Los Angeles Los Angeles, California 90012	
 Amwest Environmental Engineering 28 Centerpointe Drive, #100 La Palma, CA 90623-1054	
PROJECT NO.: CO 4017	SCALE: N.T.S.
FIGURE NO: 2	DRAWN BY: M.M.
DATE: 24/01/95	APPROVED BY: R.S.

CHEMTEK

LABORATORIES

14140 E. Alondra Boulevard
Suite A Santa Fe Springs

Telephone 310-926-8848
Teletax 310-926-8321

CERTIFICATE OF ANALYSIS

Job No: 411013

Date: 11-15-94

This is the Certificate of Analysis for the following samples:

Client Work ID: Amwest Environmental
Project Name/No.: Marine Corps/CO4017
Date Received: 11-09-94
Number of Samples: 4
Sample Type: Soil

Samples were labeled as follows:

SAMPLE IDENTIFICATION

LABORATORY NUMBER

SP-1
SP-2
SO-1
NO-2

411013-01A
411013-02A
411013-03A
411013-04A

MCC

1700 Stadium Way
Los Angeles, CA

Reviewed and Approved:

Michael C.C. Lu

Michael C.C. Lu
Laboratory Director

HEMTEK

ENVIRONMENTAL
LABORATORIES

14140 E. Alondra Boulevard
Suite A Santa Fe Springs

Telephone 310-926-848
Teletax 310-926-8321

Client: Amwest Enviromental
Project: CO-4017
Job No: 411013

Date: 11-15-94

Analysis: EPA 418.1

Reporting Unit: mg/kg

Sample ID: See below
Lab Sample ID: See below
Sample Date: 11-09-94
Analysis Date: 11-15-94

Sample IDs	Lab ID	Results (mg/kg)	Detection Limit (mg/kg)
SP-1	01A	7440	10
SP-2	02A	1660	10
SO-1	03A	ND	10
NP-2	04A	ND	10

ND: Not Detected (at the specified limit).

14140E Alondra B. de
San A Santa B. Springs

Telephone 310-926-848
Teletax 310-926-832

418.1 (TRPH)
QA/QC REPORT

Job No.: 411013 Unit: mg/kg
Lab Sample ID: 411013-Blank
Date Performed: 11-11-94

<u>ANALYTE</u>	<u>ORIG.</u> <u>RESULT</u>	<u>SPK</u> <u>CONC</u>	<u>MS</u>	<u>%</u> <u>MS</u>	<u>MSD</u>	<u>%</u> <u>MSD</u>	<u>RPD</u>	<u>ACP</u> <u>%MS</u>	<u>ACP</u> <u>RPD</u>
TRPH	ND	30.0	32.6	109	32.3	108	1.0	80-120	0-20

HEMTEK

INC.

ENVIRONMENTAL
LABORATORIES

1414 E. Alondra Boulevard
Suite A Santa Fe Springs, CA 90686

TEL: 310-926-8848
Teletax: 310-926-8324

Client: Amwest Environmental
Project: CO-4017
Job No: 411013

Date: 11-15-94

Analysis: EPA 8020 (BTEX) (Reporting unit: $\mu\text{g}/\text{kg}$)

Sample ID: See below
Lab Sample ID: See below
Sample Date: 11-09-94
Analysis Date: 11-14-94

Sample IDs Client Lab	DF	Benzene	Toluene	Ethyl- benzene	Xylenes	SURROGATE (a,a,a- Trifluorotoluene)	SPK Conc PPB	%RC
SP-1 01A	5	49.9	ND	ND	ND		40	92.3
SP-2 02A	5	29.8	ND	ND	ND		40	94.5
SO-1 03A	5	13.6	ND	ND	ND		40	89.5
NO-2 04A	5	30.7	ND	ND	ND		40	97.9
Detection limit:		5	5	5	15			
Method Blank 1		ND	ND	ND	ND		40	96.7

DF: Dilution Factor

ND: Not Detected (at the specified limit)

CHEMTEK

ENVIRONMENTAL
LABORATORIES

41401 Job: 411013
Sample: 3 Sample

Telephone 310-926-8324
Telex 310-926-8324

EPA 8020 (BTEX)
QA/QC REPORT

Unit: $\mu\text{g/kg}$

Job No.: 411013
Lab Sample ID: 411013-03A
Date Performed: 11-14-94

<u>ANALYTE</u>	<u>ORIG. RESULT</u>	<u>SPK CONC</u>	<u>MS</u>	<u>% MS</u>	<u>MSD</u>	<u>% MSD</u>	<u>% RPD</u>	<u>ACP %MS</u>	<u>ACP RPD</u>
Benzene	13.6	20.0	21.3	106.5	19.1	95.5	7.1	80-120	0-20
Toluene	ND	20.0	19.0	95.0	19.2	96.0	1.0	80-120	0-20



EPA

May 4, 1998



Pete Wilson
Governor

Los Angeles
Regional Water
Quality Control
Board

101 Centre Plaza Drive
Monterey Park, CA
91754-2156
(213) 266-7500
FAX (213) 266-7600

Mr. Morgan Rogers
Business Line Team Leader
Naval Facilities Engineering Command
South West Division, Code 522
1220 Pacific Highway
San Diego, CA 92132-5187

**UNDERGROUND STORAGE TANK CASE CLOSURE - NAVAL & MARINE CORPS
RESERVE CENTER
1700 STADIUM WAY, LOS ANGELES, CA (ID# 900120334)**

Dear Mr. Rogers,

This letter confirms the completion of the site investigation and remedial action for the underground storage tank(s) formerly located at the above-described location. Thank you for your cooperation throughout this investigation. Your willingness and promptness in responding to our inquiries concerning the former underground storage tanks is greatly appreciated.

Based on the available information and with the provision that the information provided to this agency was accurate and representative of site conditions, no further action related to the underground storage tank release is required.

This notice is issued pursuant to a regulation contained in Section 2721(e) of Title 23 of the California Code of Regulations.

Please contact Mrs. Mercedes Hsu at (213) 266-7613 if you have any questions regarding this matter.

Sincerely,

DENNIS A. DICKERSON
Executive Officer

JAMES D. KUYKENDALL
Assistant Executive Officer

cc: Ms. Diana Romero, State Water Resources Control Board, Underground Storage Tank
Cleanup Fund
Captain Dennis Wilcox, City of Los Angeles, Fire Department



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Our mission is to preserve and enhance the quality of California's water resources and ensure their proper allocation and efficient use for the benefit of present and future generations.

Appendix N

Regulatory Agency Comments and Navy Responses

**Response to Comments
for
Draft Site Inspection Report, Naval and Marine Corps Reserve Center
Los Angeles, California**

The following review comments for the Draft Site Inspection Report, December 2000 were made by Triss M. Chesney, P.E. for the Department of Toxic Substances Control (DTSC) on November 27, 2001.

	GENERAL COMMENTS	RESPONSE
1.	<p>Section 4.4.2, Volatile Organic Compounds and Section 4.4.3, Semi-volatile Organic Compounds: Common laboratory contaminants such as acetone, 2-butanone (also referenced as methyl ethyl ketone or MEK), and phthalates were detected in soil samples. If applicable, these chemicals should be evaluated relative to detected concentrations in blank samples to determine if they are site-related contaminants.</p> <p>According to the <i>USEPA Contract Laboratory Program, National Functional Guidelines for organic Data Review</i> (United States Environmental Protection Agency, EPA 540/R-99/008, October 1999), "Positive sample results should be reported unless the concentration of the compound in the sample is less than or equal to 10 times the amount in any blank for the common volatile laboratory contaminants (methylene chloride, acetone, 2-butanone, and cyclohexane), or 5 times the amount for other volatile target compounds." Additional information can also be found in chapter 5.5, Comparison of Concentrations of Detected in Blanks with Concentrations Detected in Samples of <i>Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual</i> (Part A), Interim Final (EPA, EPA 540/1-89/002, December 1989).</p>	<p>The detected concentrations for common laboratory contaminants have been assessed in relationship to their associated blank samples and revised accordingly. This was done during the preparation of the Preliminary Draft SI Report. A second review was performed with no new findings for this Final SI Report.</p>

**Response to Comments
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	GENERAL COMMENTS	RESPONSE
2.	<p>Section 4.5.3, Semi-volatile organic Compounds: Common laboratory contaminants such as phthalates were detected in groundwater samples. If applicable, these chemicals should be evaluated relative to detected concentrations in blank samples to determine if they are site-related contaminants.</p>	<p>The detected concentrations for common laboratory contaminants have been assessed in relationship to their associated blank samples and revised accordingly. This was done during the preparation of the Preliminary Draft SI Report. A second review was performed with no new findings for this Final SI Report.</p>
3.	<p>Table 4-3, Summary Statistics for Soil Sample Results, NMCRC-LA, 1999-2000: A majority of the chemicals detected are either constituents or additives of gasoline or diesel fuel. However, 2-Butanone, acetone, carbon disulfide, tetrachloroethene (also referenced as perchloroethylene or PCE, bis(2-ethylhexyl)phthalate and the polychlorinated biphenyl (PCB) Aroclor 1260 were also detected. Please provide information regarding the potential sources for these compounds.</p>	<p>A thorough investigation was performed for the preparation of the Preliminary Draft SI Report to identify any potential sources of contamination. All potential sources are listed in the SI in Sections 1.2 and 1.3.</p>
4.	<p>Table 4-8, Summary Statistics for Groundwater Samples Results, NMCRC-LA, 1999-2000: A majority of the chemicals detected are either constituents or additives of gasoline or diesel fuel. However, chloroform, carbon sulfide, PCE and di-n-butyl phthalate were also detected. Please provide information regarding the potential sources for these compounds.</p>	<p>A thorough investigation was performed for the preparation of the Preliminary Draft SI Report to identify any potential sources of contamination. All potential sources are listed in the SI in Sections 1.2 and 1.3.</p>
5.	<p>Table 7-1, COPC [Chemical of potential Concern] List for NMCRC-LA, 1999: For soil, the following chemicals were also detected but not included in Table 7-1: carbon sulfide, benzo(a)pyrene and bis(2-ethylhexyl)phthalate. For groundwater, carbon sulfide was also detected but not included in Table 7-1. Please include these chemicals in Table 7-1.</p>	<p>Table 7-1 has been revised accordingly to include those chemicals not originally listed.</p>

**Response to Comments
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	GENERAL COMMENTS	RESPONSE
6.	<p>Table 7-11, Summary of lifetime Cancer Risk and Chronic Hazard Index, NMCRC-LA: Please include the risks based on California Environmental Protection Agency cancer slope factors. Additionally, please include a summary of the cumulative risk and hazard across all media of exposure for the hypothetical future resident.</p>	<p>Except for benzene, CAL-EPA slope factors were used when available. Benzene used a slope factor that has been agreed to by the Navy and DTSC.</p>
7.	<p>Section 8.2, Recommendations: This section recommends quarterly sampling for two years to determine the status of contaminant concentrations in groundwater (i.e. increasing, decreasing, or remaining stable). The section further states, "If groundwater contaminant concentrations are not increasing, the Navy should request that DTSC officially close this site with no further action required."</p> <p>Based on the results of the human health risk assessment included in the SI report, the cumulative cancer risk and non-cancer hazards were estimated at 9.8×10^{-5} and 6.0, respectively, for the residential scenario at IR Site 1. These values exceed the acceptable cancer risk 1×10^{-6} and non-cancer hazard of 1.0. Although a majority of the risks and hazards from exposure at IR Site 1 appear to be caused by refined petroleum products, other hazardous substances as defined by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) were detected in soil and groundwater. For example, carbon sulfide, PCBs, and PCE were detected in soil and carbon disulfide and PCE were detected in groundwater. As a result, DTSC will require further action.</p>	<p>Based on Dr. Christopher's comments #7, #8, and #11 below, he believes that the results of the HHRA are conservatively high; therefore, the risk is actually lower. Modified NAPL-ADV/Johnson and Ettinger calculations were developed to determine inhalation exposure potential from soil vapors if the concrete pavement were to remain in place (This is assumed to be a current/future land-use RME scenario). For example, the initial soil concentration for 1,3,5 TMB was 0.068 mg/kg. If concrete were to remain in place the results indicate that soil concentrations levels over a time period of 30 years would gradually decline to 0.009 mg/kg and have a soil gas concentration level of 0 g/cu.m due to natural biodegradation. It is therefore reasonable to assume that a reduction in risk would be experienced if concrete is left in place.</p>

**Response to Comments
for
Draft Site Inspection Report, Naval and Marine Corps Reserve Center
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The following review comments for the Draft Site Inspection Report, December 2000 were made by John P. Christopher, Ph.D., D.A.B.T. for the Human and Ecological Risk Division (HERD) on November 20, 2001.

	COMMENTS	RESPONSE
1.	(General comment) This risk assessment is well written and clearly presented. It can become acceptable upon adequate responses to the specific comments below.	Concur.
1.	Assessment of Ambient Metals in Soil and Groundwater, Sec. 4.3, p. 4-4 ff., Appendix J: The Navy's presentation on ambient concentrations of metals is quite clear and well presented. We agree with the results described on page 4-5. For soils, Cr, Co, Mo, Ni, and V are present at Site IR-1 at levels higher than ambient conditions, although the maximum detected values for these five metals are not particularly high in comparison with other soils in the Los Angeles basin. For groundwater, Ba, Co, Pb, Ni, and Zn are present above ambient levels. The highest detected value of Ba, 445 $\mu\text{g/L}$, is particularly high.	Concur.
2.	Arsenic in Soil, Sec. 4.4.5, p. 4-11: We concur with the Navy that As is not present at IR-1 at levels higher than ambient conditions.	Concur.
3.	Figures 6-1 through 6-5, Sec. 6.4.2, p.6-5: Reference is made to figures presenting trends with time for five indicator compounds. We did not find these figures in Section 6, but we found five unnumbered figures in Appendix K presenting modeled concentrations in leachate for 1,2-dichloroethane (1,2-DCA), benzene, 1,3,5-trimethylbenzene (1,3,5-TMB), naphthalene, and Pb. If these are the five figures, please label and refer to them in a consistent manner.	The figures you identified in Appendix K were mistakenly left out from Section 6. They have been included in Section 6 for the Final SI Report.

**Response to Comments
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	COMMENTS	RESPONSE
4.	Degradation Rates, Sec. 6.4.2.1, p. 6-6: The Navy states that they used a first order decay rate for the source term. It is not clear to us whether this implies that some contaminants are being degraded within the source. If the Navy wishes to assert that biodegradation is occurring at this site, DTSC customarily requires a demonstration of such degradation <i>in situ</i> . While we would not be at all surprised to learn that hydrocarbon contaminants such as benzene are being degraded microbiologically in soil, we still require that direct evidence of such degradation be presented.	Regarding chemical degradation, it is reasonable to assume that a wide variety aerobic metabolic processes are possible in the subsurface. Hence, aerobic regions will be evident in the unconfined aquifer where the diffusion of oxygen from the vadose zone exceeds the rate of oxygen consumption in the subsurface area. In considering the subsurface biotransformation of a compound(s), a determination of the chemical's physical characteristic and the media must be considered. Although biodegradation was casually noted in sections 4.5.7 and 6.4.2.1, a more detailed discussion has been presented in the Final SI report in Section 6.4.2.
5.	Frequency of detection, Table 7-4, p. 7-17: Expressing frequencies of detection as a percent is less informative than showing a ratio of whole numbers, i.e. number of detections / number analyzed. It is not necessary to change the current report, but please use ratios of whole numbers in the future.	Future reports will use whole numbers.
6.	Risk Characterization for Exposure of the Hypothetical Industrial, Sec. 7.4.1, p. 7-7, Table 7-6: Cancer risks and non-cancer hazards are less than their respective benchmarks of 1 E-6 and 1.0, respectively, for future construction workers.	Regarding the industrial worker hypothesis (i.e. Construction Scenario), it is assumed that the worker duration period would be less than that of an adult resident. Therefore, the values used in estimating the duration period and average time spent in the area were reduced. This event promotes a skewing of the distribution curve, thus allowing for a reduction of potential risk.

**Response to Comments
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	COMMENTS	RESPONSE
7.	<p>Risk Characterization for Exposure of the Hypothetical Industrial, Sec. 7.4.2, p. 7-8, Table 7-7: We concur with the Navy's estimates of 10 E-6 for excess cancer risk and 0.16 for non-cancer hazard. Approximately 95% of the cancer risk arises from ingestion and dermal contact with polycyclic aromatic hydrocarbons in soils. Nearly all the non-cancer hazard comes from inhalation of 1,3,5-TMB from soil vapors. These estimates were made assuming the pavement were removed; therefore, the estimates are conservatively high.</p>	<p>Concur. Modified NAPL-ADV/Johnson and Ettinger calculations were developed to determine inhalation exposure potential from soil vapors if the concrete pavement were to remain in place (This is assumed to be a current/future land-use RME scenario). For example, the initial soil concentration for 1,3,5 TMB was 0.068 mg/kg. If concrete were to remain in place the results indicate that soil concentrations levels over a time period of 30 years would gradually decline to 0.009 mg/kg and have a soil gas concentration level of 0 g/cu.m due to natural biodegradation. It is therefore reasonable to assume that a reduction in risk would be experienced if concrete is left in place.</p>
8.	<p>Risk Characterization for Exposure of the Hypothetical Industrial, Sec. 7.4.3, p. 7-8 ff., Tables 7-8 & 7-9: For exposures to contaminants in soil, we concur with the Navy's estimates of 4.6 E-6 for excess cancer risk and 0.19 for non-cancer hazard. Approximately 98% of this cancer risk comes from investigation and dermal contact with polycyclic aromatic hydrocarbons in (PAH) soils. Approximately 75% of the non-cancer hazard comes from inhalation of 1,3,5-TMB from soil vapors. These estimates were made assuming complete removal of the pavement; therefore, the estimates are conservatively high.</p> <p>The Navy estimated risk and hazards separately for contaminants in groundwater. We concur with their estimate of 9 E-5 for excess cancer risk for exposure of hypothetical future residents to contaminants in groundwater. This is driven mainly by benzene (7.0 E-5) and secondarily by chloroform and 1,2-DCA. The hazard index for non-toxicity for a resident child exposed to groundwater is 5.8. Benzene, chloroform, 1,2-DCA, 1,3,5-TMB and 1,2,4-TMB drives this.</p>	<p>Concur.</p>

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	COMMENTS	RESPONSE
9.	<p>Although the Navy does not present a summary of cumulative risk and hazard across all media of exposure for the hypothetical future resident, these totals are 9.8 E-5 for cancer risk and 6.0 for non-cancer hazard. Both cancer risk and non-cancer hazard are driven mainly by exposures to volatile organic chemicals in groundwater.</p>	<p>Section 7.6 and Tables 7-12 and 7-13 have been added to the Final SI report.</p>
10.	<p>Risk due to Petroleum Components, Sec. 7.5, p. 7-10: We agree with the Navy that the great majority of the risks and hazards from exposure at Site IR-1 is caused by refined petroleum products.</p>	<p>Concur.</p>
11.	<p>Uncertainties in the Risk Estimates, Sec. 7.5, p. 7-10: HERD believes that the Navy's estimates of cancer risk and non-cancer hazard for site IR-1 are conservatively high for two reasons. First, soil contamination was found beginning at 5 ft below ground surface (bgs), and the highest concentrations of contaminants were found at greater than 20 ft bgs. Second, risk estimates for residents and industrial workers were made assuming complete removal of the pavement. Because the Navy assessed soil ingestion and dermal contact with soil as though this subsurface contamination were uncovered and at the surface. Risk managers may be assured, therefore, those cancer risks and non-cancer hazards are not under-estimated.</p>	<p>Concur. Conservative assumptions and exposure scenarios were used to depict potential future land use receptors. In using conservative assumptions, it assures the risk manager that information used in their decisions were not under estimated for potential carcinogenic and/or non-carcinogenic risk. Please also see the response to #7 above.</p>
	<p>Conclusion and Recommendation. The site inspection report and risk assessment are complete and well presented. The report has minor deficiencies, which can be cured by adequate responses to our comments. Cumulative cancer risks for residents are estimated at 9.8 E-5 and non-cancer hazards are estimated at 5.8, nearly all of which are caused by volatile organic chemicals in groundwater. For future industrial workers, cancer risk and non-cancer hazard are estimated to be 1 E-6 and less than 1.0 respectively. The great majority of these risks and hazards are caused by contaminants that are apparently the result of releases of refined petroleum products.</p>	<p>Section 7.6 and Tables 7-12 and 7-13 have been added to the Final SI report.</p>

**Response to Comments
for
Draft Site Inspection Report, Naval and Marine Corps Reserve Center
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The following review comments for the Draft Site Inspection Report, December 2000 were made by S. Steven Hariri, P.E. for the Los Angeles Regional Water Quality Control Board on June 04, 2001.

	COMMENTS	RESPONSE
1.	Submit a work plan for additional soil investigation to fully delineate soil contamination. Provide a map showing the locations of the proposed borings for the collection of additional soil samples, tables depicting the analytical methodology, and the text explaining the rationale for the number and location of additional samples.	Additional investigation is beyond the current scope of this project. The Navy will evaluate any further actions to be taken after the SI Report has been finalized.
2.	Submit a work plan for additional groundwater investigation to fully delineate groundwater contamination. Provide a map showing the proposed locations for additional monitoring wells, tables depicting the analytical methodology, and text explaining the rationale for the number and location of additional wells. Direct push technology may be used to delineate groundwater contamination prior to well installation.	Additional investigation is beyond the current scope of this project. The Navy will evaluate any further actions to be taken after the SI Report has been finalized.
3.	A California licensed land surveyor must survey all groundwater monitoring wells to a County maintained benchmark. The survey report, signed by the licensee, shall be included in the report.	Appendix F contains the survey report of the groundwater monitoring wells and is signed by the licensee.
4.	Monitoring well construction and development must comply with the requirements presented in the California Department of Water Resources' "California Well Standards" Bulletin 74-90.	Groundwater monitoring wells installed for this SI and their development complied with the requirements of Bulletin 74-90.

**Response to Comments
for
Draft Site Inspection Report, Naval and Marine Corps Reserve Center
Los Angeles, California**

	COMMENTS	RESPONSE										
5.	<p>You are required to perform quarterly groundwater monitoring. The quarterly groundwater monitoring report must be submitted by the thirtieth day following the end of the quarter, as shown in the following schedule, with the first groundwater monitoring report due on October 30, 2001:</p> <table><tr><td><u>Report Period</u></td><td><u>Report Due Date</u></td></tr><tr><td>January - March</td><td>April 30th</td></tr><tr><td>April - June</td><td>July 30th</td></tr><tr><td>July - September</td><td>October 30th</td></tr><tr><td>October - December</td><td>January 30th</td></tr></table>	<u>Report Period</u>	<u>Report Due Date</u>	January - March	April 30 th	April - June	July 30 th	July - September	October 30 th	October - December	January 30 th	Please see response numbers 1 and 2.
<u>Report Period</u>	<u>Report Due Date</u>											
January - March	April 30 th											
April - June	July 30 th											
July - September	October 30 th											
October - December	January 30 th											
6.	<p>The quarterly groundwater monitoring reports must include:</p> <ul style="list-style-type: none">• A summary of all groundwater elevation measurements from mean sea level, and depths to groundwater, from all site monitoring wells. Monitoring wells should be sounded for total depth at each gauging event. This information must be presented in tabular form. Provide a plot plan depicting the location of borings/wells with groundwater contours depicting groundwater flow direction and gradient information. Also, include a dissolved phase contaminant isoconcentration contour map for each constituent. All maps must be accurately drawn and include a scale. Include all field data forms.• Analyses of all groundwater samples collected from monitoring wells during the sampling period together with an evaluation of all test results. Groundwater sample collection and analyses shall be according to a Regional Board approved workplan.• A summary of all activities completed during the reporting period and a compilation of all modifications to the groundwater sampling plan proposed for the next reporting period. The Regional Board must approve all workplan modifications.	Additional investigation is beyond the current scope of this project. The Navy will evaluate any further actions to be taken after the SI Report has been finalized.										

**Response to Comments
for
Draft Site Inspection Report, Naval and Marine Corps Reserve Center
Los Angeles, California**

	COMMENTS	RESPONSE
7.	<p>We are enclosing the following requirements for your information. All field activities shall comply with these requirements:</p> <ul style="list-style-type: none"> • General Requirements for Subsurface Investigation • Interim Guidance for Active Soil Gas Investigation • Requirements for Soil Investigation • Requirements for Groundwater Investigation 	All field activities for this SI followed the listed requirements.
8.	<p>Pursuant to State Water Resources Control Board Resolution No. 92-49, under Water Code Section 13304, all fieldwork related to well installation must be conducted by, or under the direct responsible supervision of a registered geologist or licensed civil engineer. All technical documents submitted to the Regional Board must be reviewed and signed and/or stamped by a California registered geologist, a California registered certified specialty geologist, or a California registered civil engineer with at least five years hydrogeologic experience.</p>	A State of California Registered Geologist who has reviewed and approved the report has signed the Final SI Report.
9.	<p>The California Business and Professions Code Section 6735, 7835, and 7835.1 require that engineering and geologic evaluations and judgments be performed by or under the direction of registered professionals. Therefore, all work must be performed by or under the direction of a California registered geologist or registered civil engineer. A statement is required in the report that the registered professional in responsible charge actually supervised or personally conducted all the work associated with the report.</p>	Due to the delay in receiving written comments from all regulatory agencies pertaining to the Draft SI Report, the State of California Registered Geologist who supervised all field work is no longer employed by CDM. Another State of California Registered Geologist who has reviewed and approved the report has signed the Final SI Report.

Response to Comments
for
Draft Site Inspection Report, Naval and Marine Corps Reserve Center
Los Angeles, California

	COMMENTS	RESPONSE
10.	Pursuant to Section 13307.1 of the California Water Code, the Regional Board is required to notify all current fee title holders for the subject site of the planned action. As the identified current primary or active responsible party for corrective action and/or cleanup at the site, we are requesting that you provide us with a complete mailing list of all record fee title holders for the subject site. Therefore, please provide the name, mailing address, and telephone number of <u>all</u> record fee title holders for the subject site with a copy of the county record of current ownership, available from the County Recorder's Office, or complete the attached Certification Declaration from and submit it to our office. Please submit the required information by August 3, 2001 .	The Navy owns this property. At this present time there is no information to indicate contamination has exceeded the property boundary. Therefore, the Navy is the sole owner of the property and all associated contaminants.
11.	You are required to submit information to show the depth to the drinking water aquifer, and a scaled map showing the location of all production wells, and surface water bodies within a one-mile radius of the site. The production well information must include the following: the well owner, the well identification number, well construction detail, the most recent sample analysis results, and the status of the well. In addition, you are required to discuss the local geologic formations and lithology, which will allow this Regional Board to assess the vulnerability of the nearby drinking water supply wells, and determine any potential contaminant migration pathways to deeper groundwater zones. Please submit required information by August 3, 2001 .	Section 2.3 (Hydrology) discusses that there are no known potable or industrial water supply wells within a one-mile radius of the site.

**Response to Comments
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	COMMENTS	RESPONSE
12.	<p>The following cleanup criteria shall apply to the project at all times:</p> <ul style="list-style-type: none"> Petroleum hydrocarbons and volatile organic compounds (VOCs) --Based on site-specific conditions, soil-screening levels should be determined in accordance with the Regional Board's May 1996 Interim Site Assessment & Cleanup Guidebook, or the preliminary remedial goals (PRGs) and soil screening levels prepared by the United States Environmental Protection Agency (U.S. EPA), Region IX, whichever is lowest. Heavy metals and semi-VOCs - Based on site-specific conditions, the soluble designated level for constituents of concern should be determined in accordance with the Designated Level Mythology for Waste Classification and Cleanup Level Determination dated 1986, updated 1989, by Jon Marshak, or the PRGs and soil screening levels prepared by U.S. EPA Region IX, whichever is lowest. Please be advised that Total Threshold Limit Concentrations (TTLCs) and Soluble Threshold Limit Concentrations (STLCs) are waste classification criteria typically used for land disposal purposes. Waste classification levels are different from soil and groundwater cleanup levels, which are used for the protection of the groundwater resources and human health. 	<p>Federal, state and local governmental constraints have been reviewed to check for applicable compliance with prevailing standards and/or guidance.</p> <p>Federal, state and local governmental constraints have been reviewed to check for applicable compliance with prevailing standards and/or guidance.</p> <p>Concur.</p>
13.	<p>Risk assessments, including both human health risk assessments and ecological risk assessments, shall be conducted in areas where risk-based clean-up levels are established as clean-up criteria. Any such criterion requires approval by the Office of Environmental Health Hazard Assessment (OEIHA) and Regional Board Staff prior to implementation.</p>	<p>When relevant issues of human health risk assessments and/or ecological risk assessments are warranted, appropriate clean-up criteria have been used.</p>